ol. XXIV.—No. 154] [September, 1936

THE

MINERALOGICAL MAGAZINE

AND

Journal of

The Mineralogical Society

(*INSTITUTED FEBRUARY 3, 1876.*)

WITH A SEPARATELY-PAGED APPENDIX OF

MINERALOGICAL ABSTRACTS

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LONDON
HUMPHREY MILFORD, OXFORD UNIVERSITY PRESS,
AMEN HOUSE, WARWICK SQUARE, E.C. 4.

1936

Price 6s. net.
Annual Subscription for four numbers, Post free 20s.

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MINERALOGICAL ABSTRACTS

(Vol. 6, No. 7, September, 1936.)

Notices of Books.

HINTZE (Carl) [1851–1916]. *Handbuch der Mineralogie.* Ergänzungsband. *Neue Mineralien.* Herausgegeben von Gottlob LINCK. Berlin und Leipzig (Walter de Gruyter & Co.), 1936, Lief. 1 and 2, pp. 1–320, 92 figs. Price 16 Mk. each part.

'Hintze', the great work of reference for descriptive mineralogy, was commenced in 1889 and the series of volumes was completed in 1933 [M.A. **5**–289]. A supplementary volume now deals with the many new species of minerals which have been described during the forty-four years that the main work was in progress. The arrangement is alphabetical, including mere names as well as well-defined species, and different sections of the alphabet are allotted to different compilers—F. Heide, H. Himmel, K. Chudoba, W. Fischer, and . Köhler. The fullest possible details are given for each mineral. Part 1 covers Achlusite—Erikite, Part 2 Erikite—Magnesium-orthite, and two more parts are promised. There are frequent references to this Magazine and Abstracts. A few misprints have been noticed.

L. J. S.

RAUS (Edward Henry), HUNT (Walter Fred), & RAMSDELL (Lewis Stephen). *Mineralogy, an introduction to the study of minerals and crystals.* Third edition, New York and London (McGraw-Hill), 1936, ix + 638, 812 figs. Price 30*s.*

The first edition of this attractive text-book appeared in 1920 [M.A. **1**–116], and the second edition in 1928 [M.A. **4**–3]. The present third edition shows a further increase of 34 pages and 36 textures. Except for the determinative tables of 169 pages on differently coloured paper, the text has been reset with many minor alterations and in parts extended. The general arrangement and the chapter headings are as before. There is a short chapter on 'Gems and precious stones', and a useful chapter 'Classification of minerals according to elements' mentions the economic uses of minerals. The book is profusely illustrated, and includes 27 portraits of mineralogists, new ones in this edition being of R. Brauns, E. S. Dana, C. Palache, F. Rinne, and L. J. Spencer. L. J. S.

Spencer (L. J.). *A key to precious stones.* London and Glasgo (Blackie & Son), 1936, vii + 237 pp., 8 pls., 57 text-figs., and ke to coloured plate on dust-jacket. Price 5*s.*

The author has set a high standard for popular works on scientifi subjects. By avoiding technical treatment and using simple languag he introduces the reader to the fundamentals of the subject. Wel worn facts are given new lustre and recent discoveries are presente in a manner that is intelligible to the layman. Within the compas of a small inexpensive book, provided with a good index, is collecte considerable information formerly scattered through a voluminou literature, including much that is new to the advanced studen Part 1 deals with general principles including chapters on geologica occurrence, methods of mining, and nomenclature, the last a particu larly skilful treatment of a controversial topic. Part 2 contains th descriptive portion dealing in turn with each gemstone mineral con veniently arranged according to chemical classification. A key t the characters of the gemstone described is given at the end of eac section, and the book is illustrated throughout with reproductions o excellent photographs and the author's original drawings.

F. A. B.

Croneis (Carey) & Krumbein (William C.). *Down to earth: an intro duction to geology.* Chicago (Univ. of Chicago Press) [and Londo (Cambridge Univ. Press)], 1936, xviii + 501 pp., 64 pls., and man text-figs. Price $3·75 = 17*s.* 6*d.*

Our first impression on opening this nicely printed and profusel illustrated volume was that it was a skit on geology. This unfortu nate first impression was given by a number of 'modern drawings more suitable for a child's comic paper. It is, however, a serious an reliable work written by an Associate Professor and another memb of the Department of Geology of the University of Chicago. Th volume is one of a series of introductory books for the physic science course and for the layman in the 'University of Chicag "New Plan" texts'. The attempt at a popular style is rath strained, and the several (51) chapters rather suggest a series newspaper or magazine articles, with such titles as: 'What pri continents?', 'Universal cemetery', 'Megalomania, or the curse the dinosaurs who placed reliance on brawn, not brains'. The ma title of the book 'Down to earth' registers a complaint of the autho that the layman of the present day finds a greater appeal in popul

ooks on astronomy and other speculative subjects; and that it is gh time to take notice of more familiar and tangible matters. The otogravure plates (inserted as four sheets each of sixteen pages) are owded with pictures giving rather a scrap-book effect; and the cut- ng over of the edges and the inscriptions follow the style of the odern magazine. L. J. S.

ROCK (Lester W.). *Spectrum analysis with the carbon arc cathode layer* ("*Glimmschicht*"). With a preface by V. M. GOLDSCHMIDT. London (Adam Hilger), 1936, 56 pp., 7 pls., 12 text-figs. Price 5*s*. 6*d*.

This pamphlet, issued rather in the form of a trade catalogue, gives useful account of the new method developed by R. Mannkopff and Peters in V. M. Goldschmidt's laboratory at Göttingen, which has en used in detecting the minor constituents of minerals, rocks, ores, ., in connexion with the systematic work on the abundance and ochemistry of the chemical elements [M.A. **6**–205]. The author, o came from Philadelphia, has worked at Göttingen for two and alf years on the geochemistry of lithium, and he has been able to roduce some improvements in the technique of the method. In intense heat of the carbon arc (about 6700° C.) the metal atoms ionized and migrate to the cathode. Photographs of the spectrum m this part of the arc give more intense lines, but several precau- ns are necessary, and if more than two or three milligrams of terial are used the results are masked. By comparison with made- standards the amounts of most metals can be estimated down to 005 %. All the figures of apparatus, diagrams, spectra, and in- sity curves are labelled 'Adam Hilger, Ltd., London, England', a description of them is listed after the table of contents.

L. J. S.

GGE (S.) & KREBS (A.). *Experimentelle Grundlagen der Wellen- mechanik*. Wissenschaftliche Forschungsberichte, Naturwissen- schaftliche Reihe, Band 38. Dresden und Leipzig (T. Steinkopff), 1936, x + 236 pp., 92 figs. Price 16 Mk. (bound 17 Mk.).

his volume, forming one of a series of scientific text-books, is nly of interest to the student of experimental physics. It traces development of the quantum theory and of wave-mechanics, ng a succinct account of the experimental evidence upon which mathematical theories of Planck, Einstein, Schrödinger, Dirac, others are based. The recent work on artificial radioactivity is

also included, and a useful table of isotopes is appended giving the relative frequency of the known isotopes of each element.

F. A. B.

Platinum and allied metals. Reports on the mineral industry of the British Empire and foreign countries. Imperial Institute, Mineral Resources Department, London, 1936, 2nd edition, 137 pp. Price 3*s*.

This second edition shows an increase of 53 pages on the first edition of 1922 in the series 'War period 1913–19' [M.A. **1**–85, **5**–59]. It may also be regarded as an enlarged second edition of the volume 'The platinum metals' by A. D. Lumb (1920) [M.A. **1**–160] in the series of Imperial Institute monographs on mineral resources, now out of print. Smaller pamphlets on platinum giving statistics for 1919–21 and 1920–22 were also issued in 1924 and 1925 respectively. The present volume gives a brief account of the minerals of the platinum metals (including braggite, cooperite, and potarite described in this Magazine), mode of occurrence, mining and concentration, metallurgy, properties and uses of the metals, production and marketing. Then follow useful accounts of the occurrences of platinum metals in different countries. Statistics are given for the years 1922–35, and a detailed classified bibliography occupies 23 pages.

L. J. S.

Rock-forming Minerals and Petrology.

Chudoba (K.). *Dichte und chemische Zusammensetzung der Plagioklase auf ternärer Grundlage.* Zentr. Min., Abt. A, 1936, pp. 1–8, 3 figs.

The densities of mixtures of albite (*d* 2·618), anorthite (*d* 2·758) and microcline (*d* 2·558) in various proportions are calculated and plotted on diagrams. L. J. S.

Engels (Agnes). *Zur chemischen Zusammensetzung des Sanidin Anorthoklases vom Drachenfels, Siebengebirge.* Zentr. Min., Abt. A 1936, pp. 9–13, 1 fig.

Analysis of this felspar [M.A. **4**–389] gave SiO_2 64·40, Al_2O_3 19·40 Fe_2O_3 0·83, MgO 0·09, CaO 1·01, BaO 0·28, Na_2O 5·50, K_2O 8·11 = 99·62, sp. gr. 2·554, corresponding with $Ab_{48·02}\ Or_{46·61}\ An_{4·87}\ Ce_{0·49}$, o deducting enclosures of plagioclase $Or_{52·5}\ Ab_{47·5}$. L. J. S.

HAPMAN (Winifred M.). *A study of felspar twinning in a differentiated sill.* Amer. Min., 1936, vol. 21, pp. 33–47, 4 figs.

Samples of rock were taken from a diabase sill over a measured hickness of 1100 feet at Bridgland, Algoma, Ontario, and the felspar wins determined in thin sections on the universal stage. A statistical study of 1406 twins of eleven types shows no predominance of ny particular type corresponding with the composition of the felspar which ranges from An_{35} to An_{69}) or of the rock. The factor controlling the production of one or other type of twinning is not known.

L. J. S.

ILLS (Edwin Sherbon). *Reverse and oscillatory zoning in plagioclase felspars.* Geol. Mag. London, 1936, vol. 73, pp. 49–56, 2 figs.

In oscillatory-normal zoning it is shown that J. Phemister's theory Min. Mag. **23**–541] is theoretically impossible, and a diffusion-apersaturation theory is suggested. In reverse and oscillatory-verse zoning, the effects of the escape of volatiles, presence of other ineral constituents, and a sudden release of pressure are considered.

L. J. S.

OBOLEV (Vladimir)] Соболев (Владимир). Щелочная жила в траппе на реке Илимпее. *Alcaline dyke in the trapps of Ilimpeya-River.* Зап. Всеросс. Мин. Общ. (Mém. Soc. Russ. Min.), 1933, ser. 2, vol. 62, pp. 421–428, English summary, pp. 428–429, 1 fig.

Alkaline veinlets (few cm. thick), cutting through a dolerite dike uated in the basin of the Lower Tunguska, Siberia, are described. ne principal component of this rock is an alkali-plagioclase of the llowing composition (analysis by E. N. Egorova): SiO_2 62·14, $_2O_3$ 21·38, Fe_2O_3 3·50, MgO 0·68, CaO 2·43, BaO 0·23, Na_2O 7·30, $_2O$ 1·00, ign. loss, 0·98, total 99·64; sp. gr. 2·68, $\alpha \leq 1{\cdot}537 \leq \gamma$; varies from 52° to 62°. Alkali-plagioclases, with low 2V, were eviously observed in the trachyte of Beshtau (north Caucasus) and so described by E. D. Mountain (Min. Mag. **20**–331) as potash-goclase. This anomaly is attributed partly to the high amount of $_2O$ and partly to the strain on crystallization. The principal loured component is arfvedsonite with a large angle of extinction, $c = 30°–35°$. Among the accessory minerals are aegirine, calcite ophitic relationship with felspar), and pseudomorphs after some known mineral.

S. I. T.

[Belyankin (D. S.)] Белянкин (Д. С.). Об альбите с малым угло оптических осей с завода „Дружная Горка".—Belĭankin (D. *Albite from Druzhnaya Gorka Works having a small angle optical axes.* Докл. Акад. Наук СССР. (Compt. Rend. Acad. Sc URSS), 1934, vol. 3, pp. 651–653, English summary, pp. 653 655, 1 fig.

Albite crystals, found in the crust lining a glass-furnace vault, ar described. The analysis of the albitic crust by M. M. Stukalova i as follows: SiO_2 61·31, TiO_2 0·97, Al_2O_3 17·36, Fe_2O_3 2·07, FeO ni MnO 0·12, MgO 0·43, CaO 0·64, Na_2O 10·14, K_2O 2·92, SO_3 1·7(As_2O_5 1·63, ign. loss 0·55, total 99·90. The optical properties of th albite are: extinction in sections perpendicular to (001) (010) 14° 15°; α 1·525, γ 1·533; 2V varying from 31° to 34°. The low valu of 2V, similar to the case described by V. Sobolev (preceding abstract can be explained not so much by the anomalous composition, but b the particularly high temperature of its formation, similar to that c sanidine. S. I. T.

Horikosi (Yosikazu). *On the optical properties of glaucophanic amph boles in crystalline schists of Japan.* Japanese Journ. Geol Geogr., 1936, vol. 13, pp. 151–154, 1 fig.

Two types differing in optical orientation are distinguished (1) $\gamma = b$, $\beta : c = 18°$ about, n 1·64–1·67; pleochroism, α colourles or yellowish, β blue, γ violet or purplish-blue. Most of the Japanes occurrences are of this type, which resembles crossite. (2) $\beta = b$ $\gamma : c$ small, n 1·63–1·65, α colourless or yellowish, β purplish-blu γ blue. This is the normal glaucophane of which there are fe Japanese examples. L. J. S.

Winchell (A. N.). *Further studies in the pyroxene group.* Amer Min., 1935, vol. 20, pp. 562–568, 5 figs.

Graphs are given showing the variations in optical properties wit chemical composition in the series clinoenstatite-diopside, diopside hedenbergite, hedenbergite-clinohypersthene, and the monoclini pyroxenes $MgSiO_3$–$FeSiO_3$. L. J. S.

Winchell (A. N.). *The biotite system.* Amer. Min., 1935, vol. 20 pp. 773–779, 2 figs.

The diagrams earlier given [M.A. 3–12] are revised. Sixty three published analyses of biotite are plotted in a square wit $5H_4K_2Fe_6Al_2Si_6O_{24}$ (annite), $6H_4K_2Fe_5Al_4Si_5O_{24}$ (siderophyllite)

$H_4K_2Mg_5Al_4Si_5O_{24}$ (eastonite), and $5H_4K_2Mg_6Al_2Si_6O_{24}$ (phlogopite) ; the four corners, FeO, Fe_2O_3 (probably originally 2FeO), TiO_2, nd MgO being regarded as replaceable. A second diagram plots ie optical data for thirty-eight biotites. L. J. S.

UNO (Hisashi). *Petrological notes on some pyroxene-andesites from Hakone volcano, with special reference to some types with pigeonite phenocrysts.* Japanese Journ. Geol. Geogr., 1936, vol. 13, pp. 107–140, 2 pls., 8 text-figs.

— *On the crystallization of pyroxenes from rock-magmas, with special reference to the formation of pigeonite.* Ibid., pp. 141–150, 4 figs.

Several types of rocks are described, giving optical data for the nstituent minerals (plagioclase, anorthoclase, hypersthene, augite, geonite, olivine, biotite) and chemical analyses of the rocks. Re-rse zoning is shown by the phenocrysts of plagioclase and pyroxene the pigeonite-bearing andesites. The three pyroxenes form parallel owths, in part as reaction rims. The separation of pigeonite (with nall 2V) depends on the $FeSiO_3 : MgSiO_3$ ratio. [Cf. M.A. **5**–219.] L. J. S.

ARTH (Tom. F. W.). *The crystallization process of basalt.* (*A supplement and a reply.*) Amer. Journ. Sci., 1936, ser. 5, vol. 31, pp. 321–351, 7 figs.

A further discussion on the crystallization of felspar and pyroxene basaltic magma with progressive alteration in the composition of e magma. [M.A. **4**–508, **5**–219.] L. J. S.

OLAROWITSCH (Michel). *Sur la viscosité des roches fondues.* Compt. Rend. Acad. Sci. Paris, 1936, vol. 202, pp. 78–80.

The viscosities of the following rocks were determined by the ıthor's method (Trans. Inst. Econ. Min. U.S.S.R., 1934, no. 66) at ırious temperatures from 1100° to 1400°, and also complete analyses he figures after each rock show the viscosity in poises at 1400° and e percentage of SiO_2): basalt 49·03%, 55; teschenite 50·58 (and $Al_2O_3 + Fe_2O_3$ 23·41%), 851; andesite 63·76, 1175; olivine-basalt 2·4, 126; diabase 48·14, 60; obsidian 73·79, 170,000; and artificial ass 72·8 (and Na_2O 15·8%), 123. The viscosity increases with in-eased percentage of SiO_2 unless this is modified by the presence of rtain other substances, e.g. Na_2O. The high viscosity of teschenite at[illegible] attributable to the large amount of Al_2O_3 and Fe_2O_3. C. A. S.

Wolarowitsch (Michel) & Leontyewa (*Mlle* Anne). *Mesure du volume spécifique de la diabase fondue.* Compt. Rend. Acad. Sc. Paris, 1936, vol. 202, pp. 143–145.

The specific volumes of three samples of diabase (one analysed and containing SiO_2 51·69, TiO_2 1·98, Al_2O_3 12·96, Fe_2O_3 4·01, FeO 11·97, MnO 0·22, MgO 4·56, CaO 8·54, Na_2O 2·75, K_2O 1·34, H_2O 0·20, SO_3 0.19) were determined at several temperatures between 1090° and 1370°, whence the coefficient of dilatation of the analysed sample between 1170° and 1360° is $3{\cdot}15 \times 10^{-4}$. The coefficient of this and of one other sample increases rapidly between 1140° and 1160°, between which temperatures the viscosity also changes rapidly.

C. A. S.

Engelhardt (Wolf *von*). *Die Geochemie des Barium.* Chemie der Erde, 1936, vol. 10, pp. 187–246, 4 figs.

Numerous samples of rocks, minerals, and meteorites were examined spectroscopically for barium. In igneous rocks Ba goes with K ranging from 0·2 % BaO in syenite to 0·0003 % in peridotite, with an average of 0·048. In sedimentary rocks it is adsorbed by clay, clay-slates containing BaO 0·05 % and limestone 0·01 %. The average for the whole lithosphere is 0·045 %. Meteoric stones show $< 0{\cdot}000$ to 0·0048 % BaO. The deposition of baryte under various conditions is discussed.

L. J. S.

Backlund (H. G.). *Zur genetischen Deutung des Eklogits.* Geol. Rundschau, 1935, vol. 26, pp. 451–452.

The occurrence of eclogite with eclogite-amphibolites and amphibolites suggest that they have been formed by the progressive metamorphism of basalt through the stages amphibolite and eclogite-amphibolite.

L. J. S.

Drescher-Kaden (F. K.). *Über Assimilationsvorgänge, Migmatitbildungen und ihre Bedeutung bei der Enstehung der Magmen, nebst einigen grundsätzlichen Erwägungen.* (Vorläufiger Bericht.) Chemie der Erde, 1936, vol. 10, pp. 271–310.

Cases of rock variation around granite and gabbro masses at various well-known localities, which have hitherto been ascribed to differentiation of the magma, are now asserted to be due to assimilation of the surrounding rocks into which the magma was intruded, with the production of migmatites or mixed rocks. The bearing of this on the origin of magmas and on petrological theory is discussed. [Cf. M.A 6–223.]

L. J. S.

NHAM (Kingsley C.). *Xenoliths in the Organ batholith, New Mexico.* With a morphological description of the diopside crystals by M. A. PEACOCK. Amer. Min., 1936, vol. 21, pp. 312–320, 4 figs.

The quartz-monzonite of the Organ Mts. contains large (50–2000 t) xenoliths of granite, epidiorite, quartzite, dolomite, limestone, d shale. The mineral changes in each of these rocks are noted; t little or no contamination of the intrusive rock is evident. The nestone shows wollastonite, grossular, diopside, uvarovite, and ophyllite; and the dolomite contains periclase, brucite, forsterite, pentine, and calcite. The green diopside shows twelve crystal-ms and has α 1·672, β 1·679, γ 1·704, 2V 62°, $c:\gamma = 39°$; analysis F. A. Gonyer gave SiO_2 53·10, TiO_2 0·17, Al_2O_3 2·55, Cr_2O_3 nil, G 0·97, MnO 0·08, MgO 17·25, CaO 25·80, H_2O 0·04 = 99·96.

L. J. S.

AO (Shûichi). *On some basic inclusions in granite of Kuga district, Nagato: a study in contamination.* Japanese Journ. Geol. Geogr., 1936, vol. 13, pp. 155–162, 8 figs.

Xenoliths of meta-diabase in granite are changed into actinolite-ite-plagioclase aggregates. Changes in the composition of the erals are traced by their optical data. L. J. S.

INARD (Ed.). *La transformation de péridotites à pyroxènes en roches essentiellement siliceuses et ferrugineuses dans les bassins de la Lulua et de la Bushimaie.* Ann. Soc. Géol. Belgique, Publ. Congo Belge, 1936, vol. 59, pp. c 19–c 33, 2 pls., 2 text-figs.

eridotites in this district in Belgian Congo show an alteration ugh serpentine to a fine-grained rock composed of chalcedony, rtz, and opal, with grains of haematite and magnetite. Analyses w a range in SiO_2 from 43·25 to 90·06 %, the latter rock contain-also Al_2O_3 2·52, Fe_2O_3 4·72, MgO 1·14 %, &c. This brown chalce-ic rock is compared with birbirite from Abyssinia [M.A. **4**–46].

L. J. S.

KSTRÖM (Torsten). *The Hällefors dolerite dike and some problems of basaltic rocks.* Bull. Geol. Inst. Upsala, 1936, vol. 26, pp. 113–263, 1 pl., 31 text-figs.

his dike in Södermanland is 40 km. long W.–E. with an average h of 1 km. The whole of the western half and the marginal ion of the eastern half is occupied by rock types ('marginal s'), the main representative of which is an ophitic medium-grained ne-dolerite with a labradorite felspar $Ab_{35}An_{65}$. The central

portion of the eastern half is occupied by a 'central series' rangin from coarse-grained dolerites to porphyrites with fine-grained ground mass, the felspar here being andesine $Ab_{60}An_{40}$. These two serie are sharply separated and probably represent separate intrusion derived from the same magma. There are associated minor intrusion of adamellite, quartz-albite-rock, and granophyre, and local helsin kitic and epidote-breccia modifications. L. J. S.

Eckermann (Harry *von*). *The Loos-Hamra region*. Geol. För. Förh Stockholm, 1936, vol. 58, pp. 129–343, 110 pls., 26 text-fig Separate as Meddel. Stockholms Högskolas Min. Inst., no. 80.

This is a remarkable piece of detailed work on the geology an petrography of a small area in Sweden (about 61° 40′ N., 15° E. It includes the Mansjö Mt. area previously described by the auth [M.A. **1**–396]. A large variety of igneous and metamorphic roc (quartzite, leptite, migmatite, granite, monzonite, porphyry, po phyrite, diabase, eulysite, &c.) are described, with 114 new chemic analyses and optical data for the constituent minerals. A speci feature is the numerous excellent plates. The petrological ma (85 × 60 cm., scale 1 : 100,000) is artistically coloured, and the micr sections of rocks show unusually large areas. L. J. S.

Simmons (W. C.) & Harwood (H. F.). *Petrology of the Kilembe copp deposits*. Bull. Geol. Surv. Uganda, 1935, no. 2, pp. 13–2 5 figs.

The rocks collected by A. D. Combe are described and two analys of granulites and one of alaskite-pegmatite are given. The sequen of events at this mine is given as: intrusion of pegmatites into gran lites, interrupted crystallization near the end of the intrusion, sol tions causing alteration of hornblende to epidote, biotite to chlori and deposition of some sphene and tourmaline, pyrite, chalcopyri and a little linnaeite and some magnetite deposited in parts of t granulite richest in ferromagnesian minerals. Dolerite dikes in th area are subsequent to the mineralization. W. C. S.

Lacroix (Alfred). *Composition minéralogique des roches volcaniques l'Ile de Pâques*. Compt. Rend. Acad. Sci. Paris, 1936, vol. 20 pp. 527–530.

—— *Composition chimique des laves de l'île de Pâques*. Ibid., pp. 60 605.

Easter Island (27° 8′ S., 109° 25′ W.) has three volcanic peal Tere-vaka, with andesitic basalts of two types, aphyric and dolerit

h with occasional pigeonite as the pyroxene and porphyritic labra-
ite; Rano Kao, dacite-andesites and rhyolites; and Poike, rhyo-
s. These last include a black obsidian with needles of pyroxene
l lamellae of sanidine in a colourless glass of fatty lustre and
nchoidal fracture; and an obsidian of vitreous lustre containing
all phenocrysts of orthoclase and anorthite, and also diopside and
alite. Elsewhere on the island occur rhyolitoids of a character
found elsewhere in the Pacific area; near Rano Kao these are
ite or streaked grey and purple, aphyric and containing flattened
rolites of orthoclase with much tridymite; near Poike they are
de up of a grey paste with phenocrysts of orthoclase, acid plagio-
se, zircon, and biotite with some olivine transformed into idding-
. Complete analyses (12 new) of 16 of these lavas are given and
cussed, showing that they belong to the nepheline-free series
racteristic of many oceanic islands in the south Pacific.

C. A. S.

QUES (Maurice). *Sur les relations des amphibolites et des péridotites à Sarrazac (Dordogne).* Compt. Rend. Acad. Sci. Paris, 1936, vol. 202, pp. 332–334.

The massif of Sarrazac consists of a series of metamorphosed erup-
rocks, which chemical analysis shows to be classifiable into four
ips: (1) an olivine-labradorite-gabbro partly transformed into
phibolite with green hornblende associated with zoisite; (2) an
valite in which the anorthite and olivine have combined to form
dorite-amphibolite for which the name *sarrazacite* is proposed;
peridotite altered to resemble a cortlandite; and (4) an andesitic
ro altered to garnet-amphibolite. C. A. S.

ITA (Tôru). *On the chemical compositions of the Cenozoic alkaline suite of the circum-Japan Sea region.* Journ. Shanghai Sci. Inst., Sect. 2, 1935, vol. 1, pp. 227–306, 30 figs.

21 chemical analyses (24 of which are new) of alkali rocks from
ern Japan, Korea, and Manchuria are tabulated. They range
nepheline-basalt (SiO_2 35·66 %) to comendite (SiO_2 75·18 %).
are associated with trachybasaltic rocks similar to those of the
ern Asiatic rock province, which represent the parent magma of
alkali rocks. The distribution of these rocks is indicated on
s, and their relations and distinction from the calc-alkali rocks of
Japanese province are represented on variation diagrams.

L. J. S.

Ross (Clarence S.). *Mineralization of the Virginia titanium deposit* Amer. Min., 1936, vol. 21, pp. 143–149.

The deposits of rutile and ilmenite occur as irregular dissemination in felspar-rock and as intruded lenses and dikes of nelsonite. Th felspar-rock, of the anorthosite type but consisting of andesine ar microcline, has been invaded by iron- and magnesium-bearing sol tions giving rise to secondary actinolite, clinozoisite, and biotit These solutions also gave rise to the titanium deposits, which are n differentiates from the magma. L. J. S.

Watanabe (Takeo). *On the brucite-marble (predazzite) from the Nant mine, Suian, Tyôsen (Korea). The geology of the Suian gold mini district. (1st report.)* Journ. Fac. Sci. Hokkaidô Imp. Univ Ser. 4, 1935, vol. 3, pp. 49–59, 2 pls., 1 text-fig.

This is a fine-grained rock resembling ordinary white marble, ar consists of calcite 68·6, brucite 30·9, serpentine 0·5 %. It occurs the contact-zone of granodiorite intrusive into dolomite and slate, ar is associated with biotite-hornfels and Ca-Mg silicate rocks. Th brucite (ω 1·566, ϵ 1·584) shows evidence of being pseudomorpho after periclase. The thermal metamorphism under low pressure caus the escape of some CO_2 with the formation of periclase. L. J. S.

Larsson (Walter). *Vulkanische Asche vom Ausbruch des chilenisch Vulkans Quizapú (1932) in Argentina gesammelt. Eine Stud über äolische Differentiation.* Bull. Geol. Inst. Upsala, 193 vol. 26, pp. 27–52, 7 figs.

Fine white dust collected on the Olguita farm near Alto Aleg prov. Córdoba [800 km. NE. of the Quizapú volcano] after the eru tion of 1932 [M.A. 5–374] consists of particles 0·055–0·0027 mm. diameter, the bulk (68·4 %) being 0·0137–0·0055 mm. It consis mainly (95·8 %) of glass (n 1·495–1·497, d < 2·385, SiO_2 69·35 % with felspar (2·6 %), hornblende, pyroxene, apatite, and magneti (0·2 %). Analysis of the ash gave SiO_2 70·20, Al_2O_3 14·86, FeO 1·2 CaO 1·88, Na_2O 4·46, K_2O 4·43 %, &c. Published analyses of materi collected at different localities show that close to the volcano the a is more basic than the original material; at a little distance away has the same composition; while with increasing distance there is gradual increase in the silica percentage. This aeolian differentiatio of volcanic ash may have been a more important factor in earli geological periods of greater volcanicity, e.g. the leptites of Fenn scandania. A description is also given of volcanic ash collected

Carlos de Bariloche in Patagonia [100 km. east of the volcano] the eruption of Calbuco in Chile in 1929. L. J. S.

BRICK (Shailer S.). *The contact metamorphism of the Onawa pluton, Piscataquis County, Maine.* Amer. Journ. Sci., 1936, ser. 5, vol. 31, pp. 1–40, 11 figs.

small (11 × 3 miles) plutonic mass intrusive into Silurian slates ists in the centre of granite surrounded by quartz-monzonite and odiorite and with a basic border of diorite to gabbro. Some and quartz veins with tourmaline penetrate into the surround- slates. It is surrounded by a metamorphic aureole with an age width of 3500 feet in which are three well-marked zones: an r zone of andalusite-schist; an intermediate zone of hornfelses of us types with sericite, andalusite, cordierite, fibrolite, tourma- biotite, &c.; and an inner zone of injection hornfelses with ic veinlets. L. J. S.

ELL (R. Dana). *The mineral composition of atmospheric dust collected at Baton Rouge, Louisiana.* Amer. Journ. Sci., 1936, ser. 5, vol. 31, pp. 50–66.

mples from the dust storms of April 1934 (and April 1935) were ared. The volume per cent. by size of particles is 0·050–0·100, (1); 0·025–0·050, 4 (9); 0·005–0·025, 30 (50); < 0·005 mm., 0). The material was separated into lighter and heavier portions ntrifuging in bromoform, and particles > 0·01 mm. were identi- and counted under the microscope. The lighter portion contained nic glass 42 (24), plant fragments, &c. 18 (5), quartz 21 (53) %; leven other minerals were identified. In the heavier portion 2·88; 1 % of the whole) thirty-five minerals were identified, ding 'black metallics' 25 (22), haematite with some limonite 5), epidote 21 (27) %, &c. The relative abundance of volcanic is evidently due to its concentration by suspension in the air. 1934 dust came from the northern plains, and that of 1935 from outh. L. J. S.

INSON-LESSING (F. Y.)] Левинсон-Лессинг (Ф. Ю.). Статистическая характеристика химизма трахитов.—LOEWINSON-LESSING (F.). *Statistische Charakteristik des Chemismus der Trachyte.* Изв. Акад. Наук СССР, Отд. матем. и ест. наук (Bull. Acad. Sci. URSS, Cl. sci. math. nat.), Leningrad, 1933, pp. 101–109, 5 figs. (Russian with German summary.)

e statistical study of 210 analyses of trachytes gave the following

averages: SiO_2 60·44%, acidity coeff. 2·40 (variation 2·25–2·55); RO (from the magmatic formula of the author) 1·21 (variation 1·14–1·24); R_2O:RO 2·34. S. I. T.

[Levinson-Lessing (F. Y.) Левинсон-Лессинг (Ф. Ю.) Статистическая характеристика химизма базанитов.—Loewinson-Lessing (F. J.) *Étude statistique du charactère chimique des basanites.* Труд. Петр. Инст. им. Ф. Ю. Левинсон-Лессинга, Акад. Наук СССР (Trav. Inst. Petrogr. Loewinson-Lessing, Acad. Sci. URSS), Leningrad, 1935, no. 5, pp. 5–11. (Russian with French summary.)

The statistical study of 168 analyses of basanites and related rocks gave the following averages: SiO_2 for basanites 42·12% (variation 39–45), for limburgites 42 (40–45), for melilite-basalts 37·1 (35–39); acidity coeff. for basanites 1·20; $\overline{RO}$ (from the magmatic formula of the author) for basanites 3·3, for limburgites 3·20, for melilite-basaits 5·02. A transitional type is called basanito-basalt. S. I. T.

[Levinson-Lessing (F. Y.)] Левинсон-Лессинг (Ф. Ю.). К вопросу о генезисе изверженных пород.—Loewinson-Lessing (F.). *Sur la genèse des roches éruptives.* Труд. Мин. Муз. Акад. Наук СССР (Trav. Mus. Min. Acad. Sci. URSS), 1929, vol. 3, pp. 1–11

—— Проблема генезиса магматических пород и пути к ее разрешению. *The problem of the origin of magmatic rocks.* Изд. Акад. Наук СССР (Publ. Acad. Sci. USSR), Leningrad, 1934, 58 pp.

In the second and more extensive of these two papers a good critical summary is given of all the recent theories of differentiation and genesis of igneous rocks. Stress is laid on the importance of the study of petrographical provinces and formations in their geological and petrochemical relationships. The possibility of various processes (crystallization, liquation, distillation, assimilation, anatexis) as factors in differentiation is suggested. Two fundamental magmas—basic and acid—are postulated, while the relative scarcity of intermediate rocks is emphasized. The existence of a third, ultrabasic magma, is subjected to criticism, as peridotites can be considered merely as differentiates of the basic magma. Syenitic rocks apparently illustrate a case of heterogeny, as there is a possibility that they can represent differentiates either of an acid or a basic magma. Three categories of magmatic products are postulated: (1) Prototectites—products of crystallization of the primary magma or its differentiates

Anatectites—products of remelting of a portion of the crust ually affected by a differentiation); (3) Syntectites—products of xing of magmas without differentiation or products of magmatic similation of foreign material with a subsequent differentiation.

S. I. T.

EVINSON-LESSING (F. Y.) & VOROBIEVA (O. A.)] LOEWINSON-LESSING (F.) and VOROBJEVA (O.). *Contribution to the knowledge of orbicular structures in igneous rocks.* (Левинсон-Лессинг (Ф. Ю.) и Воробьева (О. А.). К вопросу о шаровых структурах в изверженных породах.) Докл. Акад. Наук СССР (Compt. Rend. Acad. Sci. URSS), 1929, pp. 351–356, 1 fig. (English).

The following terms for orbicular rocks are proposed: (1) 'allo-rausmatic'—spheroids formed round rock-fragments of different mposition from that of the groundmass; (2) 'homeothrausmatic' d 'isothrausmatic' in which spheroids are produced round frag-nts similar in composition, or identical with the groundmass of rock, respectively. Orbicular rocks of the second type are pro-ed by means of plutonic autobrecciation. This thesis is supported the modal analyses of typical orbicular rocks. S. I. T.

EVINSON-LESSING (F. Y.)] Левинсон-Лессинг (Ф. Ю.). О своеобразном типе дифференциации в вариолите Ялгубы (пример ликвации магмы на две несмешивающиеся жидкости).—LOEWINSON-LESSING (F.). *On a peculiar type of differentiation represented by the variolites of Yalguba in Karelia (a case of splitting of an effusive basic magma into two immiscible liquids.* (English summary.) Труд. Петр. Инст. Акад. Наук СССР (Trans. Petrogr. Inst. Acad. Sci. USSR), 1935, no. 5, pp. 21–27.

The work published by the author in 1884 is revised, and new lyses of the varioles (I) by V. A. Moleva and the groundmass by V. A. Egorov from the variolite of Yalguba are given. The k is glassy with a few microphenocrysts of pyroxene and black dles of titanomagnetite(?). Apparently these two minerals crystal-d out first. This was followed by the liquation-differentiation of magma into droplets of an alkali-silica-rich portion and a calc-omagnesian basic portion which formed the groundmass.

SiO_2.	TiO_2.	Al_2O_3.	Fe_2O_3.	FeO.	MnO.	MgO.	CaO.	Na_2O.	K_2O.	H_2O.
60·54	1·82	11·88	0·94	6·00	0·22	5·00	7·30	3·94	1·06	1·57
38·89	1·11	16·25	3·26	12·96	0·28	6·89	14·50	0·15	0·10	5·67

S. I. T.

[Belyankin (D. S.) & Petrov (V. P.)] Белянкин (Д. С.) и Петр (В. П.). О шаровом граните из Кангасниеми.—Beljankin (D. and Petrov (W. P.). *On orbicular granite from Kangasnie* (English summary.) Труд. Петр. Инст. Акад. Наук СС (Trans. Petrogr. Inst. Acad. Sci. USSR), 1932, no. 3, pp. 21–5 figs.

A new interpretation is given of the genesis of the well-kno orbicular granite from Kangasniemi (central Finland), which has b already described by several Scandinavian petrologists. Ignor gneiss xenoliths, the rock is composed of the following parts: (1) c tral nuclei of the orbicules; (2) aplitic-pegmatitic zonal envelop (3) interorbicular groundmass. The alkali-felspathic fraction (2 supposed to have been formed later than (1) and (3) under the in ence of gaseous emanations on the enclosed granitic fragments [Cf. M.A. **4**–40.] S. I. T.

[Belyankin (D. S.)] Белянкин (Д. С.). О сферолитах в техничес стекле и о некоторых шаровых образованиях в магматичес горных породах.—Beliankin (D. S.). *Über Sphärolithe technischen Glase und über einige kugelförmige Bildungen in magmatischen Gesteinen.* (German summary.) Труд. Петр. Ин Акад. Наук СССР (Trans. Petrogr. Inst. Acad. Sci. USSR), 19 no. 4, pp. 5–20, 5 figs.

This is a critical examination of the data relating to spherul found in technical glasses and in igneous rocks. The following c clusions are reached: in technical glasses the difference between composition of the spherulites and of the groundmass is very sm in acid igneous rocks it is more marked, while in basic rocks (va lites) it is considerable. The possibilities of magmatic liquatior subsequent selective weathering are briefly discussed. S. I. T.

[Fersman (A. E.)] Ферсман (А. Е.). О новой закономерности сост гранитных пегматитов.—Fersman (A.). *Sur une nouvelle lo la composition des pegmatites granitiques.* Докл. Акад. Н СССР (Compt. Rend. Acad. Sci. URSS), 1931, pp. 115–122.

Granite-pegmatite magma is considered a closed system obey the mineralogical phase-rule as formulated by V. M. Goldschn (1911). The statistical data indicate that in granite-pegmatites, the average, the number of minerals (phases) is 20–25, while number of chemical elements (components) is 18–23. S. I. T.

VRUSEVICH (B. A.)] Гаврусевич (Б. А.). К минералогии топазовых пегматитов Украины.—GAVRUSEVIČ (B.). *Contributions à l'étude de la minéralogie des pegmatites de topaze en Ukraïne.* Докл. Акад. Наук СССР (Compt. Rend. Acad. Sci. URSS), 1932, pp. 173–181, 1 fig.

he granite-pegmatite dikes and veins in the red granite and bro-norite of the province of Volhynia (north of Zhitomir) are sub-ded into two groups, following the classification of A. E. Fersman: Pegmatites of pure descent, (2) Pegmatites of hybrid descent. matites of the first group are composed of orthoclase-perthite, rtz, albite, zinnwaldite, &c., and an analysis by N. I. Vrevskaya typical graphic pegmatite from Pisarevskaya Guta is given: 74·31, Al_2O_3 13·61, Fe_2O_3 0·49, MnO nil, CaO 0·51, MgO trace, trace, Na_2O 4·52, K_2O 5·45, ign. loss 0·77, total 99·66. In the matites of this group topaz (pink, bluish, and colourless) up to , and beryl up to 60 kg., were found. The hybrid pegmatites r in the gabbro-norite and are characterized by the additional nce of labradorite, pyroxene, hisingerite, and pyrrhotine. Miaro-cavities show the following order of crystallization: colourless tz → calcite → smoky-quartz → orthoclase → amethyst → hisinge-→ brown clay. [M.A. **3**–27.] S. I. T.

EDKO (A. F.)] Соседко (А. Ф.). Пегматиты Алтын-Тау (центральные Кызыл-Кумы).—SOSEDKO (A.). *Les pegmatites d'Altyn-Taou (Kyzyl-Kumy central).* Докл. Акад. Наук СССР (Compt. Rend. Acad. Sci. URSS), 1932, pp. 251–259, 3 figs.

the upper margin of a granite intrusion of Altyn-Tau (Central numerous pegmatite veins have been found, and the following rals have been recorded: alkali-felspar, biotite, muscovite, tz, garnet, gahnite, pyrite, tourmaline, beryl, kaolinite, graphite, columbite. Gahnite (black, lustre vitreous, H. 8) has been ysed by I. D. Borneman: SiO_2 0·3, Al_2O_3 54·69, Fe_2O_3 10·64, 31·6, MnO 0·6, Cu 0·5; Sp. gr. 4·49. S. I. T.

YANKIN (D. S.) & KUPLETSKY (B. M.)] Белянкин (Д.) и Куплетский (Б.). Горные породы и полезные ископаемые Северного Побережья и прилегающих к нему островов Кандалакской губы Белого моря. *The rocks and mineral deposits of the northern shore and the adjoining islands of the Kandalakskaya bay of the White Sea.* Научно-Техн. Отд. В.С.Н.Х., no. 7, Труд. Сев. Научно-Пром. Эксп., Вып. 18 (Sci.-Techn. Dep. Supr. Council

Nat. Econ., no. 7, Trans. North. Sci. Econ. Exped., no. 18) Moscow-Leningrad, 1924, 75 pp., 1 map.

Besides a description of the pre-Cambrian rocks and the sulphid ores of the south coast of Kola peninsula, the authors give a detaile account of the intrusive alkali rocks of a later age, comprising th following types: ijolite, nepheline-syenite, augite- and mica-porphy rites and turjite (турьит). Turjite is a name given to a new roc type composed of orange-coloured mica (40 %), analcime (20 %), ca cite (20 %), and melanite (20 %). Apatite in small quantities is als present and some varieties of turjite contain nepheline and pyroxen The analysis of turjite from Turja peninsula by M. G. Oknov is a follows: SiO_2 30·56, TiO_2 1·16, Al_2O_3 11·86, Fe_2O_3 6·07, FeO 4·2 MnO 0·28, MgO 6·10, CaO 19·11, Na_2O 2·59, K_2O 4·20, CO_2 8·7 Cl 0·11, H_2O+ 3·97, H_2O- 0.76, total 99·77. Comparison of analys suggests a similarity of turjite, mica-porphyrite, and alnöite.

S. I. T.

[Belyankin (D. S.), Vlodavetz (V. I.), & Shimpf (A.)] Белянкин (Д. Влодавец (В.) и Шимпф (А.). Горные породы и полезные иск паемые окрестностей сс. Умбы и Порьей Губы. *The rocks an mineral deposits of the region of Umba and Porja Guba.* Научн Техн. Отд. ВСНХ, no. 37, Труд. Сев. Научно-Пром. Эксп., Вы 20 (Sci.-Techn. Dep. Supr. Council Nat. Econ., no. 37, Tran North. Sci. Econ. Exped., no. 20), Moscow-Leningrad, 192 43 pp., 9 maps (2 pp.).

This paper is a continuation of the account of the geology of t south shore of Kola peninsula and the adjoining islands (precedi abstract). The pre-Cambrian rocks with the associated pegmatit and sulphide veins are described first. The alkali rocks (mostly dike are described in detail. The nepheline-melilite-lepidomelane-roc named turjaite by W. Ramsay in 1921, and turjite are compare Chemically these two types are similar, but turjaite is richer in Ti and P_2O_5, while turjite is richer in CO_2 and H_2O. A fine-graine phase of turjaite is described under the name of micro-turjaite. T confusion that will inevitably occur between the two names (turji and turjaite) was pointed out by E. H. Kranck, who also described this region at a later date [M.A. **4**–43].

S. I. T.

[1] M.A. 4–43. The abstract is not quite correct. Belyankin called the calcit bearing veins turjite and not turjaite. At that time he did not know about t name proposed by W. Ramsay.

Belyankin (D. S.) & Turtzev (A.)]. Белянкин (Д.) и Турцев (А.). К изучению гранито-диабасовых контактов на восточном побережьи и на островах Онежского озера.—Beliankin (D.) und Turzeff (A.). *Zur Kenntniss der Granit-Diabasischen Kontakte an den östlichen Küsten und den Inseln des Onega-Sees.* Изв. Ленингр. Полит. Инст. (Bull. Leningrad Polytechn. Inst.), 1925, vol. 29, pp. 215–222.

Along the eastern shore and the islands of lake Onega are found umerous intrusions of diabase in the granite. At certain contacts re found rocks produced by the action of the basic magma on anite—'fused' granite and hybrids between granite and basic magma. he diabase is either labradorite-bearing with micro-pegmatite or bite-bearing. The hybrid rocks are rich in albite and, in the opinion the authors, illustrate the genesis of albite in the magmatic stage.

S. I. T.

Kupletsky (B. M.)] Куплетский (Б. М.). К петрографии Хибинских Тундр. 4. Породы восточного Умптека.—Kupletskij (B.). *Notes pétrographiques sur les Monts Chibines. 4. Roches de l'Umptek oriental.* Труд. Мин. Муз. Акад. Наук СССР (Trav. Musée Minér. Acad. Sci. URSS), 1926, vol. 1, pp. 83–164 (Russ.), pp. 165–166 (Germ. summary), 1 pl. (map), 5 text-figs.

The Khibina tundra (Umptek) and Lovozero tundra (Luyavrurt) e situated approximately in the middle of Kola peninsula. The ibina tundra is formed mainly by an arcuate concentric nepheline-enite complex with numerous associated rocks of alkali affinity. e size of this plutonic complex is 36×26 km. The intrusive uence was apparently from the periphery towards the centre. The ter zone is formed of chibinite (coarse-grained pegmatitic nephe-e-syenite) with umptekite at the contact with the country-ks. Then followed the injection of trachytoid chibinite (second g) and dikes of medium-grained aegirine-nepheline-syenite. The tre of the massif is occupied by fine-grained mica- and hornblende-heline-syenites. The phase of minor intrusions is represented by series of melanocratic dikes: monchiquite, theralite, alnöite, rite-porphyry, ore-pyroxenite, and a series of leucocratic dikes, luding varieties rich in cancrinite and pectolite. The last intru-e phase also includes astrophyllite-nepheline-syenite and ijolite-ite with associated apatite-nepheline-rock. The principal rock es are minutely described and seven analyses of rocks and one of nblende are given.

S. I. T.

[Kupletsky (B. M.)] Куплетский (Б. М.). Арфведсонитовый порфир из ущелья Гакмана в Хибинских тундрах. *The arfvedsonite-porphyry from Hackman's gorge in Khibina tundra.* Изв. Акад. Наук СССР (Bull. Acad. Sci. URSS), 1927, pp. 579–592, 1 fig.

The arfvedsonite-porphyry was found as loose blocks, but it is probably derived from a local dike. It contains large (up to 3 cm. long) phenocrysts of arfvedsonite, poikilitically enclosing crystals of the groundmass—anorthoclase, nepheline, albite, ilmenite, and apatite. The analyses of the phenocrysts and the groundmass are given as well as the calculated composition of arfvedsonite. The optical properties of arfvedsonite are α 1·676, β 1·688, γ 1·702, 2V 64°–72°, positive, optic-axial plane (010); pleochroism α dark bluish-green, β greenish or greyish-brown, γ yellowish-brown or greyish-yellow, absorption $\alpha > \beta > \gamma$. Extinction-angle on (001) 0°, on (110) 12·3°. S. I. T.

[Vlodavetz (V. I.)] Влодавец (В. И.). О двух новых месторождениях щелочных пород на Кольском полуострове.—Vlodavec (V.) (Wlodavetz (W.)). *Sur deux gisements nouveaux des roches alcalines dans la presqu'île de Kola.* Докл. Акад. Наук СССР (Compt. Rend. Acad. Sci. URSS), 1928, pp. 361–365.

Dikes of natrolite-syenite near Poukh-Ozero and an outcrop of alkali-syenite near Kont-Ozero are described, and two chemical analyses of these rocks are given. S. I. T.

[Vlodavetz (V. I.)] Влодавец (В. И.). Нефелино-апатитовые месторождения в Хибинских тундрах. С вступительной статьей акад. А. Е. Ферсмана Нефелино-апатитовая проблема. *Nepheline-apatite deposits of Khibina tundra.* With an introduction by A. E. Fersman *on the apatite-nepheline problem.* Труд. Инст. по Изуч. Севера, Вып. 46, Научно-Техн. Упр. ВСНХ, no. 33 (Trans. Inst. Explor. of the North, no. 46, Sci. Techn. Dep. Supr. Counc. Nat. Econ. USSR), 1930, 60 pp., 16 figs. (Russian with English summary.)

This is the result of the survey of the nepheline-apatite deposits carried on in the summer of 1928 under the leadership of the author. The nepheline-apatite-rock occurs in the form of lenticular bands, average 200 m. thick, representing either separate intrusions, or schlieren, between a fine-grained nepheline-syenite (hanging-wall) and urtite-ijolite (foot-wall). The total length of the arcuate outcrops is about 10 km., and the dip in its middle is 30° NE. The upper part of the nepheline-apatite deposit (the spotted zone) contai

bout 80% of apatite. This zone, through an intermediate spotty-riated zone, passes down into the lower striated zone, richer in epheline and poorer in apatite (about 20%). The apatite-rich rock, ccording to the terminology of D. Belyankin [M.A. **4**–220], is called apaneite' (apatite 60–80, nepheline 15–35, aegirine, arvfedsonite, iotite, sphene, and ore about 5%), while the nepheline-rich rock is alled 'neapite' (apatite 20–50, nepheline 40–70, aegirine, biotite, phene, and ore 5–10%). Several analyses of rocks and minerals are iven. The following analyses by N. I. Vlodavetz from the Kukis-umchorr outcrop may be taken as typical: apaneite (I), neapite (II), patite (III) from the middle zone, nepheline (IV).

	SiO_2.	TiO_2.	ZrO_2.	Al_2O_3.	Rare-earths.	Fe_2O_3.	FeO.	MnO.	MgO.	CaO.
I.	5·76	0·22	0·06	6·98	0·85	0·45	0·59	0·25	0·10	44·02
I.	30·89	1·30	0·07	21·26	0·06	3·44	3·86	0·10	1·62	15·96
I.	0·04	—	—	0·67	0·73	0·07	—	—	0·13	53·54
V.	43·16	0·06	—	31·03	—	1·13	0·45	—	0·06	0·17

	SrO.	BaO.	Na_2O.	K_2O.	P_2O_5.	F.	Cl.	H_2O.	Total.
I.	2·26	0·07	1·39	0·75	34·73	1·85	0·29	0·55	101·17
I.	0·44	0·15	8·56	2·58	7·65	0·30	0·27	0·54	99·76
I.	2·12	0·08	1·40	0·09	40·42	1·97	0·09	0·28	101·64
V.	—	—	16·94	6·88	—	—	—	0·31	100·19

II, also CO_2 0·70, S 0·01. III, also V_2O_5 0·05.

It is suggested that the nepheline-apatite portion of the magma parated from its parent urtite-ijolite magma and was subsequently ncentrated at the roof of the intrusive chamber. [Cf. M.A. **6**–232.]

S. I. T.

UPLETSKY (B. M.) & VOROBIEVA (O. A.)] Куплетский (Б. М.) и Воробьева (О. А.). Геолого-петрографические наблюдения на центральном водоразделе Кольского полуострова летом 1928 г.— KUPLETSKY (B.) u. WOROBJEVA (O.). *Geologisch-petrographische Beobachtungen auf der centralen Wasserscheide der Halbinsel Kola.* Труд. Ленингр. Общ. Естествоисп. (Trav. Soc. Natur. Leningrad), 1930, vol. 60, pp. 49–77, 4 pls., German summary, pp. 77–78.

The results of the survey of a hitherto unexplored region of the tral part of Kola peninsula (east of lake Lovozero) are presented. e western border of a large alkali-granite massif is described. The nite contains arvfedsonite, aegirine, and a mineral of the astro-llite group [M.A. **5**–34, **6**–285]. Several analyses of rocks and nerals are given.

S. I. T.

[Fersman (A. E.)] Ферсман (А. Е.). Геохимическая диаграмма Хибинских тундр.—Fersman (A.). *Diagramme géochimique des Monts Chibines.* Докл. Акад. Наук СССР (Compt. Rend. Acad. Sci. URSS), 1931, pp. 193–198, 1 fig.

An interpretation of the geochemical diagram (sequence of crystallization of minerals in a cooling magma including the pegmatitic and the hydrothermal stages) of the Khibina tundra alkali complex is given. The agpaitic sequence of Khibina tundra is compared with sequences in other alkali complexes and the relation between the order of crystallization and the order of intrusion is outlined. S. I. T.

[Fersman (A. E.)] Ферсман (А. Е.). Геохимические дуги Хибинских тундр.—Fersman (A.). *Les arcs géochimiques des Monts Chibines.* Докл. Акад. Наук СССР (Compt. Rend. Acad. Sci. URSS), 1931, pp. 367–376.

A general discussion of the geochemistry of the district in relation to the igneous tectonics. The Khibina tundra represents a plutonic complex with an arcuate or horse-shoe shaped arrangement of successive intrusions, with a gradual displacement of the centre from west to east. S. I. T.

[Kupletsky (B. M.)] Куплетский (Б. М.): Кукисвумчорр и прилегающие к нему массивы центральной части Хибинских тундр по съемкам 1929 и 1930 гг. [*Kukisvumchorr and the adjoining massifs of the central part of Khibina tundra as surveyed in 1929 and 1930.*] Мат. по петр. и геохим. Кольского Полуострова. Част. I. Труд. сов. по изуч. произв. сил, Сер. Кольская, Вып. 2, Акад. Наук СССР (Mater. for petr. and geochem. Kola peninsula. Part I, Trans. Counc. Stud. Econ. Res., Kola Ser., no. 2, Acad. Sci. USSR), Leningrad, 1932, pp. 5–72, 1 map.

The area surveyed includes the deposits of the apatite-nepheline rock [M.A. **6**–232, 308, 312], but it deals principally with the petrology of various plutonic rock types entering into the composition of the arcuate complex of Khibina tundra. The intrusive series (from the periphery to the centre) are as follows: (1) chibinite, (2) ijolite-urtite, (3) lujavrite, (4) apatite-nepheline-rock, (5) mica-nepheline-syenite (outer), (6) aegirine-nepheline-syenite, (7) mica-nepheline-syenite (inner), (8) pyrrhotine zone, (9) leucocratic foyaite, and the late dike rocks—nepheline-syenite, cancrinite-porphyry, tinguaite, monchiquite, alkali-basalt. The rocks are described in great detail and fifteen rock and five mineral analyses are given besides a number of

odal analyses. A new name rischorrite (рисчоррит) is applied to mica-nepheline-syenite with a characteristic intergrowth of alkali-lspar and nepheline. Analysis I by K. A. Argentov is that of ris-horrite from Kaskasnunachorr and analysis II by V. A. Egorov is f mica (lepidomelane) from a pegmatitic segregation in rischorrite om Kukisvumchorr.

	SiO_2.	TiO_2.	ZrO_2.	Al_2O_3.	Fe_2O_3.	FeO.	MnO.	MgO.	BaO.	CaO.
.	54·99	0·46	0·02	21·36	2·23	2·58	0·12	0·85	trace	0·33
.	36·53	6·09	—	8·99	4·41	19·91	0·75	9·03	0·58	—

	Na_2O.	K_2O.	P_2O_5.	CO_2.	F.	Cl.	H_2O+.	H_2O-.	Total.
.	7·32	8·72	0·56	0·02	—	—	0·39	0·20	100·15
.	0·83	8·98	—	0·27	1·25	0·01	2·20	0·83	100·66

The pyrrhotine enriched zone (pyrrhotine average 16·3 %) is of no mmercial value. In the discussion of the genesis of alkali rocks Khibina and Lovozero tundras, the author is reluctant to express definite view at the present stage of investigation, although he is clined towards the hypothesis of C. H. Smyth as the most probable.

S. I. T.

OROBIEVA (O. A.)] Воробьева (О. А.). Геология и петрография Эвеслогчорра и прилегающих к нему высот в Хибинских тундрах. [*The geology and petrography of Eveslogchorr and the adjoining heights in Khibina tundra.*] Мат. по петр. и геохим. Кольского Полуострова. Часть I. Труд. сов. по изуч. произв. сил, Сер. Кольская, Вып. 2, Акад. Наук СССР (Mater. for petr. and geochem. Kola peninsula, Part I, Trans. Counc. Research Econ. Res., Kola Ser., no. 2, Acad. Sci. USSR), Leningrad, 1932, pp. 73–104, 1 map, 7 text-figs.

The paper deals with the area adjoining on the south-east the area scribed by B. M. Kupletsky (preceding abstract). A similar suc-ssion of ring intrusions is present. The rocks are described and veral analyses are included.

S. I. T.

UPLETSKY (B. M.)] Куплетский (Б. М.). Геолого-петрографическая характеристика Чуна-тундры на Кольском полуострове.— KUPLETSKY (B. M.). *Geologisch-petrographische Charakteristik der Tschuna-Tundre auf der Halbinsel Kola.* (German summary.) Мат. по петр. и геохим. Кольского полуострова. Часть III. Труд. сов. по изуч. произв. сил, Сер. Кольская, Вып. 5, Акад. Наук СССР (Mater. for petr. and geochem. Kola peninsula, Part

III, Trans. Counc. Research Econ. Res., Kola Ser., no. 5, Acad. Sci. USSR), Leningrad, 1933, pp. 5–53, 6 pls., 1 map.

Chuna tundra (west of Lake Imandra, Kola) comprises a basic plutonic complex of Karelian or Caledonian age, intrusive in pre-Cambrian gneisses. The early intruded gabbro and basic dikes were subsequently affected by metamorphism and tectonic movements, and later intruded by gabbro-norite, peridotite, pyroxenite, diabase, pegmatite, and aplite. The rocks are described and nine analyses are given, including one analysis of augite from a gabbro-pegmatite.

S. I. T.

[Antonov (L. B.)] Антонов (Л. Б.). Апатитовые месторождения Хибинской тундры. [*The apatite deposits of Khibina tundra.*] Хибинские Апатиты, VII. Госхимтехиздат (Khibina Apatite, vol. 7, State Chem. Techn. Publ.), Leningrad, 1934, pp. 1–196, 3 maps, 103 text-figs.

As pointed out by A. E. Fersman in the introduction to this volume, the present work is the first detailed description of the largest apatite deposit in the world. The author gives a general account of the geology of Khibina tundra and a complete review of the principal rock types. A new rock is described under the name *lujavritite* (luiavritite), which differs from lujavrite by an almost complete absence of felspar and a greater proportion of aegirine. In its chemical composition (SiO_2 44·58, TiO_2 3·40, Al_2O_3 11·50, Fe_2O_3 8·07, FeO 4·91, MnO 0·29, MgO 4·02, CaO 9·78, SrO 0·20, BaO nil, Na_2O 8·35, K_2O 2·08, P_2O_5 0·84, H_2O 0·31, ign. loss 1·01, total 99·34), it approaches felspatic ijolite with which it is genetically connected. Lujavritite is a porphyritic rock with a trachytoidal texture and characteristic elongated crystals of aegirine. Sphene and arfvedsonite are present in a small amount. The crescent-shaped intrusion of the urtite-ijolite complex with the associated apatite-nepheline-rock is situated between lujavritite and lujavrite. The previously published work by V. I. Vlodavetz is amplified and all the different varieties of the apatite-nepheline-rock are minutely described. New analyses of apatite show the presence of rare earths of the cerium group from 0·95 to 1·23 %, and fluorine from 3·15 to 3·20 %. The greater part of the paper is occupied with records of the field survey, bore-holes, and chemical tests of the ore. The total estimate of the apatite-nepheline ore is 2000 million metric tons, corresponding to 430 million tons of P_2O_5. [Cf. M.A. **6**–232, 308, 310.] S. I. T.

UPLETSKY (B. M.)] Куплетский (Б. М.). Ультра-основные породы Монча-тундры. KUPLETSKY (B.). *Ultra-basische Gesteine der Montscha-Tundre auf der Halbinsel Kola.* (German summary.) Мат. по петр. и геохим. Кольского Полуострова. Часть IV. Труд. сов. по изуч. прир. рес. и Петр. Инст., Сер. Кольская Вып. 7, Акад. Наук СССР (Mater. for petr. and geochem. Kola peninsula, Part IV, Trans. Counc. Research Nat. Res., Kola Ser., no. 7, Acad. Sci. USSR), Leningrad, 1935, pp. 5–61, 15 text-figs.

The basic and ultrabasic intrusive rocks of Moncha tundra (west of e Imandra), probably of Karelian age, are represented by an early of gabbro and gabbro-norite and a later pyroxenite-peridotite plex. In the latter complex the gravitational effect is apparent—idotite always forms the lower part of the intrusion. The final usive stage is represented by dikes of diabase and quartz-porphyry. rocks are minutely described and twelve analyses are given. h olivine and pyroxene are relatively poor in iron (averaging 2 % of iron silicate molecule). Small amounts of sulphides are ent as segregations in peridotites. The statistical study of al analyses of basic and ultra-basic rocks suggests the following enclature :

With plagioclase.		Without plagioclase.	
agioclase %.		Pyroxene %.	
85–100 ...	Anorthosite.	90–100 ...	Pyroxenite.
70–85 ...	Leucocratic gabbro.	65–90 ...	Olivine-pyroxenite.
30–70 ...	Gabbro, norite.	30–65 ...	Peridotite.
15–30 ...	Melanocratic gabbro.	10–30 ...	Pyroxene-olivinite.
0–15 ...	Gabbro-pyroxenite.	0–10 ...	Dunite, olivinite.

S. I. T.

OROBIEVA (O. A.)] Воробьева (О. А.). Геолого-петрографическое строение Волчьей тундры.—VOROBJEVA (O. A.). *Die geologisch-petrographische Structur der Woltschaja-Tundra.* Мат. по петр. и геохим. Кольского Полуострова. Часть IV. Труд. сов. по изуч. прир. рес. и Петр. Инст., Сер. Кольская, Вып. 7, Акад. Наук СССР (Mater. for petr. and geochem. Kola peninsula, Part IV, Trans. Counc. Research Nat. Res., Kola Ser., no. 7, Acad. Sci. USSR), Leningrad, 1935, pp. 63–94, 2 pls., 12 text-figs.

preliminary survey of Volchia tundra (north of Moncha tundra,) is presented. The following rocks are described : (1) Archaean gneiss and injection-gneiss, (2) gabbro-norite series, and (3)

hypersthene-quartz-diorite series. Eleven analyses of rocks a
included. S. I. T.

[Oknova (T. M.)] Окнова (Т. М.). Химико-минералогическое иссл
дование гранитов и диабазов восточного побережья Онежско
озера. *Chemical and mineralogical researches of the granites a
diabases of the eastern shore of the Onega lake.* Труд. Пет
Инст. им. Ф. Ю. Левинсон-Лессинга, Акад. Наук СССР (Tra
Inst. Petrogr. Loewinson-Lessing, Acad. Sci. USSR), Leningra
1935, no. 5, pp. 29–52, 2 pls., 2 text-figs. (Russian with Engli
summary.)

This is a continuation of the work of D. S. Belyankin a
A. Turtzev [M.A. **6**–307]. Quartz-diabase (Konga type) from t
island of Kladovetz (anal. I) has the following modal composition
labradorite (anal. II) 59·18, enstatite-augite (anal. III, with admi
ture of about 10 % labradorite) 31·50, magnetite 0·75, hornblen
2·65, microcline 3·64, quartz 2·03, biotite 0·25. Enstatite-augite
optically positive with 2V 43° and $\gamma : c = 39°$. The average co
position of micropegmatite is quartz 36, microcline 64 %. T
granite from the shore of lake Onega (anal. IV) is composed of olig
clase, microcline, quartz, and accessories (biotite, muscovite, epido
apatite). Near the diabase contact the granite shows signs of
melting with the formation of micropegmatite, albite, and hornblend
Numerous veins and dikes cutting both rocks are represented
granite-aplite (anal. V) and a dark hybrid rock (anal. VI). T
aplite with relict crystals of fused oligoclase surrounded by mic
pegmatite suggest a product of the regenerated granite magma. T

	I.	II.	III.	IV.	V.	VI.
SiO_2 ...	52·68	52·40	52·12	68·88	75·16	58·75
TiO_2 ...	0·86	—	0·52	0·22	0·40	1·76
Al_2O_3 ...	17·01	27·61	7·03	16·09	12·19	12·90
Fe_2O_3 ...	2·73	1·29	0·14	1·10	0·84	4·60
FeO ...	5·41	0·49	13·88	1·51	1·33	7·86
MnO ...	0·22	—	0·33	0·10	0·04	0·32
MgO ...	5·38	0·30	13·27	0·77	0·44	1·94
CaO ...	10·55	12·02	11·39	3·33	1·00	5·60
BaO ...	0·06	—	—	0·07	—	0·06
Na_2O ...	3·43	5·03	1·69	5·73	4·33	2·04
K_2O ...	1·02	0·91	0·17	1·99	4·41	4·38
P_2O_5 ...	0·10	—	—	—	0·06	—
CO_2 ...	0·12	0·22	—	—	—	—
Loss ign. ...	0·43	0·57	0·38	1·30	0·57	0·14
	100·00	100·84	'101·10'	101·09	100·77	100·35

brid rock is rich in hornblende and biotite, while microcline and artz are also present. S. I. T.

EBEDEV (P. I.) & MOLEVA (V. A.)] Лебедев (П. И.) и Молева (В. А.). Пневматолитовая порода Приазовской кристаллической полосы.— LEBEDEFF (P. I.) and MOLEVA (V. A.). *Pneumatolytic rock of the Azov sea-shore crystalline mass.* Труд. Петр. Инст. им. Ф. Ю. Левинсон-Лессинга, Акад. Наук СССР (Trav. Inst. Petrogr. Loewinson-Lessing, Acad. Sci. URSS), Leningrad, 1935, no. 5, pp. 13–20, 4 figs. (Russian with English summary.)

A vein, up to 0·5 m. thick, of a fluorite-apatite-rock showing a dual transition to mariupolite has been discovered in an alkali- ite in the region of Kalchik river. It is medium-grained and a mottled violet colour. The analysis by V. A. Moleva gave: $_2$ 14·20, TiO_2 0·19, Al_2O_3 5·15, Fe_2O_3 2·40, FeO 0·88, MnO 0·36, O 1·24, CaO 47·28, 'ZrO' trace, Na_2O 1·50, K_2O 1·21, P_2O_5 8·10, 28·30, H_2O 0·90, total 111·71, less O for F 11·91, total 99·80. calculated, the analysis roughly corresponds to fluorite 50·92, aramite 29·26, apatite 19·57. Fluotaramite [Min. Mag. **20**–466] blue alkali-hornblende of crossite-crocidolite type. Its optical perties are: 2V 55°, negative, $\gamma - \alpha$ 0·006, ext. angle 25°, pleo- ism γ deep blue, β bluish-grey, α yellowish-blue, absorption $\beta \geq \gamma$. Fluotaramite is intergrown with a green hornblende hastingsite type (2V 68°, negative, $\gamma - \alpha$ 0·025, pleochroism γ lowish-green, β deep green, α brownish-green). A certain amount feldspar is also present. The following genetic phases are deduced: hornblende-apatite; 2, fluorite-apatite; 3, apatite-hornblende- par. S. I. T.

UCHITZKY (V. I.) & LEBEDEV (P. I.)] Лучицкий (В. И.) и Лебедев (П. И.). Петрография Украины. [*The petrography of Ukraine.*] Петр. СССР под ред. акад. Ф. Ю. Левинсон-Лессинга. Сер. I. Регион. Петр. Вып. 3, Петр. Инст. Акад. Наук СССР (The petrography of USSR, edited by F. Y. Loewinson-Lessing, ser. I, Regional Petrography, no. 3, Petrogr. Inst. Acad. Sci. USSR), Leningrad, 1934, 324 pp., 14 pls., 1 map, 42 text-figs.

The present volume gives a summary of the petrology of the amorphic and igneous rocks of the Ukrainian pre-Cambrian ck, which stretches from Volhynia to the Azov sea, but is greatly cured by a cover of later sediments. It is pointed out in the oduction that unfortunately a large amount of new material

obtained during the recent geological survey has not been includ
The first part (pp. 9–162) written by V. I. Luchitzky contai
a general account of the regional distribution of rocks and a detail
petrographical description of the older schists, migmatites, gabbr
norites, granites, and of certain younger hypabyssal and volca
rocks (some definitely of a Carboniferous age). The second part
P. I. Lebedev (pp. 163–324) combines a summary with an accou
of an original research on the gabbro-anorthosite-charnockite compl
of Volhynia and on the alkali complex of the Azov region.
a sense, the unity of the presentation is broken by the dual auth
ship of the book and there is a certain amount of overlapping. So
250 analyses and minute descriptions of the rocks make this bo
a valuable source of information, but the absence of an index and
a general map of the region makes it a little difficult for purposes
reference. S. I. T.

[Kupletsky (B. M.)] Куплетский (Б. М.). Щелочные пегмати
Мариупольского района. *Alkali pegmatite des Mariupolisch
rayon.* Труд. Петр. Инст. им. Ф. Ю. Левинсон-Лессинга, Ак
Наук СССР (Trav. Inst. Petrogr. Loewinson-Lessing, Acad. S
URSS), Leningrad, 1932, no. 3, pp. 39–51, 6 figs. (Russian wi
German summary.)

The alkali-pegmatites of the Mariupol region are assigned to t
groups: (1) pegmatites of the alkali-syenites with microcline, aegiri
and hastingsite; (2) pegmatites of the mariupolites with albi
nepheline, aegirine, sodalite, cancrinite, natrolite, zircon, and bioti
The alkali-rocks cut the peridotites of the region and are therefo
later in order of intrusion. This is contrary to the scheme propos
by J. Morozewicz [M.A. **4**–395]. S. I. T.

[Besborodko (N. I.)] Безбородько (Н. И.). Монцонитовый ряд
монцониты Украины. *The monzonite series and the monzonites
Ukraine.* Труд. Петр. Инст. им. Ф. Ю. Левинсон-Лессин
Акад. Наук СССР (Trav. Inst. Petrogr. Loewinson-Lessing, Ac
Sci. URSS), Leningrad, 1935, no. 5, pp. 169–207, 3 figs. (Russi
with English summary.)

A critical examination of the monzonite series in the light of t
numerous Ukrainian examples. Monzonite is defined as a gene
term embracing several types: sommaite = leucite-monzonite,
sexite = nepheline-monzonite, kentallenite = olivine-monzonite, ma
gerite = quartz- and olivine-free monzonite, and quartz-monzoni

new data given comprises the following rocks: kentallenite, near ky (anal. I); kentallenite, near Volianschina (anal. II); quartz-nzonite near Book (anal. III); ukrainite near Chermalyk (anal. IV). rainite is composed of orthoclase-perthite, plagioclase (An_{30}), llage, quartz, hornblende, magnetite, biotite, and apatite. Another l member of the monzonite series from Varvarovka (anal. V) urs in association with the rock of the bugite series [M.A. **6**–122], charnockite-norite series.

SiO_2.	TiO_2.	Al_2O_3.	Fe_2O_3.	FeO.	MgO.	CaO.	Na_2O.	K_2O.	P_2O_5.	H_2O.
49·52	—	18·38	3·91	11·56	3·23	7·68	2·79	1·99	—	0·23
46·16	3·03	14·37	1·51	16·95	3·75	6·72	2·76	1·96	1·25	1·25
61·20	—	17·05	2·11	5·70	0·82	3·10	4·17	4·28	—	0·22
57·91	—	15·34	4·15	7·69	1·80	4·32	4·01	3·64	—	0·76
59·16	—	18·28	1·38	7·51	1·31	4·45	4·81	3·63	—	0·30

S. I. T.

ZBORODKO (N. I.)] Безбородько (Н. И.). Граниты Волыни и их пегматиты.—BESBORODKO (N.). *Les granites de Volynie et leurs pégmatites*. Вісн. Україн. Від. Геол. Ком. (Bull. Sect. de l'Ucraine Com. Geol.), Kieff, 1929, no. 13, pp. 25–82, 11 pls. (Russian with French summary.)

ight principal types of granites in Volhynia are distinguished and cribed, together with the associated pegmatites. The effects of tamination and migmatization are discussed and ten analyses of ks are given. S. I. T.

VINSON-LESSING (F. Y.), GINSBERG (A. S.), & DILAKTORSKY (N. L.)] Левинсон-Лессинг (Ф. Ю.), Гинзберг (А. С.), и Дилакторский (Н. Л.). Траппы Тулуно-Удинского и Братского районов в Восточной Сибири.—LOEWINSON-LESSING (F.), GINSBERG (A.), und DILAKTORSKY (N.). *Die Trappe des Udinsk-Tuluner Rayons und des Bratsker Rayons in Ost-Sibirien*. (German summary.) Труд. сов. по изуч. произв. сил, Сер. Сибирская, Вып. 1, Акад. Наук СССР (Trans. Counc. Research Econ. Res., Siberian Ser., no. 1, Acad. Sci. USSR), Leningrad, 1932, 82 pp., 9 pls., 11 text-figs.

his is a full account of the work on the Siberian traps [M.A. **5**–371]. traps (dolerites and gabbro) occur in the form of large sills and colites, and are remarkably uniform in their composition. They characterized by the presence of hortonolite, a partial analysis which by M. M. Stukalova is: FeO 43·77, MgO 21·26, CaO 0·51, the optical properties: 2V from 71° to 80°, negative, marked

dispersion $r > v$, α 1·769 ± 0·005 (for a crystal with 2V 72°–74°). Th crystallization of hortonolite overlaps that of plagioclase but precede that of pyroxene. The analysis of pyroxene is: SiO_2 50·26, TiO_2 2·31, Al_2O_3 1·57, FeO 11·70, MnO 0·17, MgO 14·45, CaO 17·9 Na_2O 0·30, K_2O 0·06, H_2O+ 1·17, H_2O- 0·16, total 100·13; an its optical properties: 2V from 45° to 50°, positive, α 1·710 ± 0·0 (for a crystal with 2V 46°–48°). The plagioclase varies from An to An_{70}. In certain cases quartz-orthoclase intergrowths are prese in the mesostasis. The mechanics of igneous intrusion and th technical applications of the rocks are discussed. S. I. T.

Loewinson-Lessing (F.). *Über die Raumbildung großer flacher In trusivlager*. Min. Petr. Mitt. (Tschermak), 1932, vol. 43, p 271–282.

—— *A contribution to the mechanics of intrusion*. Rep. XVI Inte nat. Geol. Congr., Washington, 1933 (reprint, 1935), 14 pp.

These two papers are the outcome of the study of Siberian tra (preceding abstract). It is suggested that the emplacement of magn in the formation of sills and sheet-like batholiths depends on the mov ment of the crust and not on the magma's own activity. The magn is not forced into the earth's crust, but gradually occupies the spa liberated by the sinking foot-wall (Platzaustausch, emplacement). S. I. T.

[Unksov (V. A.)] Унксов (В. А.). Траппы района рек Уды-Чун Тасеевой, Восточная Сибирь. [*The traps of the region of Ud Chuna-Taseieva rivers, eastern Siberia.*] Труд. сов. по изу произв. сил, Сер. Сибирская, Вып. 18, Акад. Наук СССР (Tra Counc. Research Econ. Res., Siberian Ser., no. 18, Acad. Sc USSR), Leningrad, 1934, 60 pp., 7 pls., 2 maps, 10 text-figs.

The region described adjoins that of Udinsk-Tulun previous studied by F. Y. Loewinson-Lessing and others (preceding abstracts The traps (dolerites) occur mainly in the form of large sills intrude at different horizons of the Lower Paleozoic sandstones and shale Ophitic olivine-dolerite with an iron-rich olivine, is the domina rock. Another variety, described under the name of pegmatit trap, is richer in pyroxene. It is also slightly richer in SiO_2, TiO and K_2O than the ophitic variety. Pyroxene is usually idiomorphi Fayalite and micropegmatite are present. Graphic intergrowths pyroxene, felspar, and titanomagnetite are sometimes observed. Th felspar is slightly more alkaline (An 35–50), and the pyroxene

her in iron oxides than the corresponding minerals in the ophitic iety. The pegmatitic trap apparently represents the residual oduct of the basic magma. Ten analyses of rocks, one of pyroxene, l a number of modal analyses are given. S. I. T.

EVINSON-LESSING (F. Y.)] Левинсон-Лессинг (Ф. Ю.). Заметка о химизме базальтов с р. Хатанги в Сибири. *Note sur le caractère chimique des basaltes de la rivière Khatanga en Sibérie arctique.* Труд. Петр. Инст. им. Ф. Ю. Левинсон-Лессинга, Акад. Наук СССР (Trav. Inst. Petrogr. Loewinson-Lessing, Acad. Sci. URSS), Leningrad, 1935, no. 5, pp. 53–56. (Russian with French summary.)

The consideration of four new analyses of effusive basalts from tic Siberia shows their similarity to the intrusive dolerites [M.A. 317] and also to other arctic basalts and dolerites (Greenland, land, Franz Joseph Land, &c.). They belong to the fissure-erupted e of plateau basalts, and in contrast to the basalts of the Pacific ion show no evidence of differentiation. S. I. T.

UPLETSKY (B. M.)] Куплетский (Б. М.). Материалы к петрографии приполярной Сибири между рр. Яной и Алазеей.—KUPLETSKIJ (B.). *Zur Petrographie des Polargebietes von Sibirien zwischen den Flüssen Jana und Alaseja.* Изв. Акад. Наук СССР, Отд. Физ.-Мат. (Bull. Acad. Sci. USSR, Phys.-Math. Cl.), 1930, pp. 1029–1051. (Russian with German summary.)

A microscopical description is given of the material collected by ious expeditions. The plutonic rocks are represented by quartz-nzonite and granodiorite of Svyatoy cape, both of Palaeozoic age, l by Mesozoic granite from the eastern region near the river digirka. The plutonic rocks of Svyatoy cape are cut by diabase es, and lavas of an olivine-free and pyroxene-rich basalt of Tertiary are present in both regions. S. I. T.

OZHKOV (B. N.)] Рожков (Б. Н.). Новые данные по геологии Северо-Западной окраины Енисейско-Ленской платформы.—Rožkov (B. N.). *New data on the geology of the north-western margin of the Enisei-Lena platform.* Бюлл. Московск. Общ. Испыт. Прир. (Bull. Soc. Naturalistes, Moscou), 1932, n. ser., vol. 40 (Sect. Geol., vol. 10), pp. 268–294. (Russian with English summary.)

An account is given of the geology of the region and especially of volcanic series of the Upper Carboniferous age. In the Norilsk

district the succession is as follows: upper lavas 250 m., upper tuffites 20 m., lower lavas 200–250 m., lower tuffites 10 m., productive coal beds of Tungus series (Upper Carboniferous), 125 m. Ordovician shales and limestones. In the river Severnaya district the lavas are 700 m. thick and the underlying tuffites 600–650 m. thick. The lavas are represented by basalt, diabase, amygdaloidal spilites. Autobrecciated flows are a feature. Intrusive gabbro-diabase and diabase-porphyry in the form of concordant and discordant sills and dikes are very abundant. The intrusive phase followed the extrusive phase and the igneous activity may have extended into the Mesozoic.

S. I. T.

[Kupletsky (B. M.)] Куплетский (Б. М.). Кислые породы реки Колымы.—Kupletskij (B. M.). *Acid rocks of the Kolyma river.* Колымская Геолог. Эксп. 1929–1930, том. I, часть 3. Труд. сов. по изуч. прир. ресурсов., Сер. Якутская, Вып. 24, Акад. Наук СССР (Kolyma Geol. Exped. 1929–1930, vol. 1, part 3. Trans. Counc. Research Econ. Res., Yakutian Ser., no. 24, Acad. Sci. USSR), 1935, pp. 3–64, 2 pls. (Russian with English summary.)

The effusive series of Kolyma region (NE. Siberia) is represented by alternating basic and acid lavas, eruptive breccia, and tuffs. All the rocks are characterized by a high soda content and comprise quartz-keratophyre, keratophyre, trachyte, diabase, spilite, &c. The intrusive rocks are represented by syenite, syenite-porphyry, alkali-aplite, diorite. Types richer in alkalis—aegirine-aplite, essexite, and teschenite—are also present. In their age the rocks probably range from Trias to early Tertiary. Thirty-three analyses of acid and basic rocks are included.

S. I. T.

[Kashkay (Mir-Ali)] Кашкай (Мир-Али). К петрографии интрузивных пород железнорудных месторождений Кондомского района.—Kashkay (M. A.). *On the petrography of intrusive rocks of Kondoma region.* Труд. Петр. Инст. им. Ф. Ю. Левинсон-Лессинга, Акад. Наук СССР (Trav. Inst. Petrogr. Loewinson-Lessing, Acad. Sci. URSS), Leningrad, 1935, no. 5, pp. 93–114, 1 pl. (Russian with English summary.)

The plutonic rocks of the Kondoma region (Kusnetsky Alatau) are represented by gabbro-pyroxenite-dunite and gabbro-serpentine complexes of Cambrian age, and by granite, syenite, and albitite of Caledonian age. Four chemical analyses are given.

S. I. T.

EBEDEV (P. I.)] Лебедев (П. И.). Титано-магнетито-габбровый комплекс массива Патын (Кузнецкий Алатау).—LEBEDEFF (P. I.). *The titanite-magnetite gabbro mass Patyn (western Siberia)*. Труд. Петр. Инст. им. Ф. Ю. Левинсон-Лессинга, Акад. Наук СССР (Trav. Inst. Petrogr. Loewinson-Lessing, Acad. Sci. URSS), Leningrad, 1935, no. 5, pp. 57–92, 4 pls., 7 text-figs. (Russian with English summary.)

This is a study of a banded gabbro complex of Patyn in Kusnetsky atau. The dominant gabbro (anal. I) is composed of bytownite, nopyroxene, and some titanomagnetite and biotite. Certain ies of this gabbro (anal. II) are enriched in olivine (2V 80°, nega- e) and titanomagnetite. A dark fine-grained modification of the rmal gabbro is characterized by the presence of hornblende. The roxene (anal. III) of the normal gabbro has the following optical perties: pleochroism α yellowish, β pink, γ yellowish-pink, posi- e, 2V 58°–64°, $\gamma : c = 53°–46°$. The pegmatitic-pneumatolitic ase is represented by dark coarse-grained schlieren composed of nopyroxene, ilmenite, hornblende, biotite, sphene, apatite, zoisite, ite. Acid pegmatites (anal. IV) are also present.

	I.	II.	III.	IV.
SiO_2 ...	48·64	36·46	48·44	73·58
TiO_2 ...	0·83	6·20	1·42	0·12
Al_2O_3 ...	19·62	9·17	4·47	14·22
Fe_2O_3 ...	1·13	9·45	1·79	0·45
FeO ...	4·72	12·20	8·05	0·29
MnO ...	0·10	0·73	0·28	0·02
MgO ...	8·02	7·75	13·65	0·34
CaO ...	13·89	16·24	19·10	0·20
BaO ...	—	—	—	0·04
Na_2O ...	2·22	1·16	0·50	2·12
K_2O ...	0·25	0·06	0·14	8·46
P_2O_5 ...	—	—	—	0·05
H_2O+ ...	0·72	0·52	2·10	0·38
H_2O- ...	0·10	0·28	0·10	
Cr_2O_3 ...	0·04	—	0·06	—
V_2O_3 ...	—	—	0·09	—
FeS_2 ...	0·12	—	—	—
SO_3 ...	—	—	—	0·02
	100·40	100·22	100·19	100·29

S. I. T.

BEDEV (P. I.) & LEBEDEV (A. P.)] Лебедевы (П. И. и А. П.). К геохимии титана и ванадия в западной Сибири. Ажинский габбровый комплекс Ойротии.—LEBEDEV (P.) & LEBEDEV (A.). *On*

the geochemistry of titanium and vanadium in western Siberia (*The Azhinsk gabbro complex of Oirotia*). Докл. Акад. Наук СССР (Compt. Rend. Acad. Sci. URSS), 1934, vol. 3, pp. 294–297, English summary, pp. 298–300.

The Azhinsk (north Oirotia) intrusive complex, which is probably of Caledonian age, includes a number of basic sills of gabbro and ore-pyroxenite (I) with schlieren of ilmenite-gabbro (II) (analyses by V. A. Moleva). The ore-pyroxenite is chiefly composed of augite ($\gamma : c = 45°$, 2V 56°±), brown barkevikite ($\gamma : c = 12°–14°$, 2V 84°), while titanomagnetite and pyrite are the last products of crystallization. The ilmenite-gabbro is composed of bluish-green plagioclase, dark titanaugite (III), with the following optical properties $\gamma : c = 49°$, 2V 50°, $\gamma - \alpha$ 0·030–0·032, ilmenite (late crystallization, partly altered to leucoxene), and accessory apatite, chlorite, and quartz. Partial analysis of the heavy residue suggests that vanadium is almost wholly concentrated in the ilmenite.

	SiO_2.	TiO_2.	Al_2O_3.	Fe_2O_3.	FeO.	MnO.	MgO.	CaO.	BaO
I.	38·20	4·04	6·62	8·24	14·52	0·36	10·84	12·50	n.f.
II.	41·46	4·84	12·11	1·36	12·06	0·22	7·87	14·50	n.f.
III.	35·04	8·97	9·42	3·20	16·97	0·56	9·53	14·40	—

	Na_2O.	K_2O.	V_2O_5.	P_2O_5.	S.	H_2O+.	H_2O-.	Total
I.	0·96	0·12	0·11	—	0·65	2·45	0·50	100·11
II.	1·42	0·40	0·07	0·38	—	3·36	0·20	100·28
III.	—	—	0·06	—	—	1·72	—	99·87

S. I. T.

[Zavaritzky (A. N.)] Заварицкий (А. Н.). Лампрофиры и родственные им породы на горе Магнитной.—*The lamprophyres of Magnitnaya Mountain and related rocks*. Труд. Петр. Инст. им. Ф. Ю. Левинсон-Лессинга, Акад. Наук СССР (Trav. Inst. Petrogr. Loewinson-Lessing, Acad. Sci. URSS), Leningrad, 1935, no. 5, pp. 115–126 (Russian with English summary.)

Numerous lamprophyre dikes cut the ore-bearing complex of Magnitnaya Mountain (Ural Mts.), and they all show the pneumatolitic effect attributed to a later granitic intrusion. One narrow dike, however, was found penetrating and chilling against the granite. The rock composing this dike is a fine-grained spessartite, chiefly consisting of oligoclase and brownish-green hornblende. Its chemical analysis is: SiO_2 52·37, TiO_2 1·52, Al_2O_3 14·99, Fe_2O_3 4·02, FeO 4·28, MnO 0·14, MgO 4·72, CaO 9·11, Na_2O 4·32, K_2O 2·28, H_2O- 0·72, loss ign. 2·23 = 100·70. The rock is also affected by pneumatoliti-

ction (development of scapolite and veinlets composed of sphene, bite, and quartz). In the discussion on the classification of lampro-hyres the author proposes six principal types for these rocks.

S. I. T.

Sokolov (G. A.)] Соколов (Г. А.). Гибридный гранито-габбровый Шигир-Тараташский массив на западном склоне среднего Урала.— *The phenomenon of hybridism in the gabbro-granite complex of the western slope of the Middle Urals.* Труд. Петр. Инст. им. Ф. Ю. Левинсон-Лессинга, Акад. Наук СССР (Trav. Inst. Petrogr. Loewinson-Lessing, Acad. Sci. URSS), Leningrad, 1935, no. 5, pp. 127–152, 2 figs. (Russian with English summary.)

An igneous complex of Devonian age in the region of the mountains igirskaya and Taratash is described. Three intrusive cycles are stinguished (in chronological order): (1) gabbro and gabbro-diabase, granite, and (3) diabase dikes. The hybrid rocks produced by partial assimilation of basic rocks by the granitic magma are repre-nted by femitized granite, quartz-syenite, diorite, and quartz-diorite. mposite dikes, with a hybrid zone between the outer diabase and e inner granite, are also present. The hybrid rocks show corroded ict crystals of pyroxene partly replaced by hornblende and biotite. he diabase dikes of the last cycle show a certain amount of myr-kite, and are supposed to be acidified by the incorporation of anitic fragments ('reverse contact action'). Six analyses of rocks e given. S. I. T.

X-rays and Crystal-structure.

euburger (M. C.). *Gitterkonstanten für das Jahr 1936.* Zeits. Krist., 1936, vol. 93, pp. 1–36.

Tables are given showing the atomic structure of the solid chemical ements with 140 references to the literature. H. H.

rock (Lester W.). *A classification of crystal structures with defect lattices.* Zeits. Krist., 1936, vol. 93, pp. 285–311, 2 figs.

In the ideal crystal structure equivalent points are all filled with e same sort of atom and with these only. Recently structures ve been suggested, e.g. for α-AgI, in which equivalent points are t completely filled or are occupied by different sorts of particles. ese structures are said to have 'defect lattices' and are suitably assified. H. H.

Greninger (Alden B.). *A back-reflexion Laue method for determining crystal orientation.* Zeits. Krist., 1935, vol. 91, pp. 424–432, 7 figs.

X-rays are passed through a hole in the back of a film and refracted back on to its face from an opaque crystal. The orientation of the crystal is determined by a graphical device applied to the resulting Laue photograph. H. H.

Laschkarew (W. E.). *The determination of the distribution of electron density and potential in a crystal lattice from X-ray data.* Physikal. Zeits. Sowjetunion, Charkow, 1935, vol. 8, pp. 227–239, 2 figs.

Laschkarew (W. E.) & Tschaban (A. S.). *The calculation of potential distribution in certain crystal lattices.* Ibid., pp. 240–254, 12 figs.

A new method of calculating the distribution of electron density and potential in a crystal lattice from the measured intensities of X-ray diffractions is derived and shown to be most accurate for substances belonging to the cubic system. Potential distribution data calculated by the new method are in close agreement with experimental values for lithium, aluminium, and sodium chloride. Calculated data for diamond and graphite show that the latter resembles a metal in its electronic distribution. F. A. B.

Fox (Gerald W.) & Fraser (Walter A.). *X-ray extinction in piezo-electrically oscillating crystals.* Physical Review, 1935, vol. 47, pp. 899–902, 3 figs.

Laue photographs of sections of quartz, tourmaline, and Rochelle salt show increased intensity of diffraction during piezoelectric oscillation. The effect is most marked with quartz and results from decreased extinction due to warping of lattice planes during oscillation. F. A. B.

Hocart (Raymond). *Contribution à l'étude de quelques cristaux à anomalies optiques.* Bull. Soc. Franç. Min., 1934, vol. 57, pp. 5–125, 8 pls., 26 text-figs.; Thèse Univ. Strasbourg, Paris, 1934, 129 pp., 10 pls., 26 text-figs.

The author adds to previously published work on boleite and boracite a detailed account of X-ray and optical work on specimens of pharmacosiderite, senarmontite, and apophyllite. All five minerals exhibit so-called anomalous optical properties which are shown to be due to mimetic twinning. Beautiful Laue photographs in addition to previously published oscillation photographs are well reproduced [M.A. **4**–363, **5**–316]. F. A. B.

EECHING (R.). *Some quantitative and qualitative observations on the electron diffraction pattern from the natural (111) face of diamond.* Phil. Mag., 1935, ser. 7, vol. 20, pp. 841–855, 1 pl., 3 text-figs.

Electron diffraction patterns from the (111) faces of a photo-conucting diamond do not differ from those for an ordinary diamond [M.A. **5**–209, 213]. The forbidden (222) diffraction is, however, uch stronger than for X-rays, due not to distortion of the carbon om, but rather to the interaction of the (111) and (333) beams in e crystal. F. A. B.

INCH (G. I.) & WILMAN (H.). *The diffraction of electrons by graphite.* Proc. Roy. Soc. London, Ser. A, 1936, vol. 155, pp. 345–365, 7 pls., 1 text-fig.

With graphite powder and very thin cleavage flakes from material various sources extra rings are given by electron diffraction, which e not shown in the X-ray patterns. Thicker crystals, however, ve Kikuchi lines which accord with the structure deduced from the -ray patterns. The lattice constants given by the electron diffracon method are a 2·458, c 6·701 Å. [Cf. M.A. **6**–78.] L. J. S.

UBURGER (M. C.). *Präzisionsmessung der Gitterkonstante von Silicium.* Zeits. Krist., 1935, vol. 92, pp. 313–314.

Measurements on a specimen of silicon with only 0·16 % impurity ve $5{\cdot}4173 \pm 0{\cdot}0005$ Å. for the edge of the cubic unit cell. H. H.

UBURGER (M. C.). *Gitterkonstante und Allotropie von Beryllium.* Zeits. Krist., 1935, vol. 92, pp. 474–475.

After discussion of the work done by various authors it is concluded at the best values of the edges of the unit cell of α-beryllium are $2{\cdot}2680 \pm 0{\cdot}0003$, c $3{\cdot}5942 \pm 0{\cdot}0004$ Å., with $c/a = 1{\cdot}5847$. H. H.

RADLEY (A. J.). *The crystal structure of gallium.* Zeits. Krist., 1935, vol. 91, pp. 302–316, 7 figs.

Gallium has the space-group V_h^{18}. The unit cell contains eight oms of gallium and has a 4·5167, b 4·5107, c 7·6448 Å. H. H.

UBURGER (M. C.). *Präzisionsmessung der Gitterkonstante von reinem Vanadium.* Zeits. Krist., 1936, vol. 93, pp. 314–315.

The edge of the cubic unit cell of vanadium is $3{\cdot}0338 \pm 0{\cdot}0003$ Å. 25° C. H. H.

Neuburger (M. C.). *Präzisionsmessung der Gitterkonstante von se reinem Niob.* Zeits. Krist., 1936, vol. 93, pp. 158–159.

The edge of the cubic unit cell of niobium was measured 3·2941 ± 0·0003 Å. at 20° C. H. H.

Neuburger (M. C.). *Präzisionsmessung der Gitterkonstante von se reinem Tantal.* Zeits. Krist., 1936, vol. 93, pp. 312–313.

The edge of the cubic unit cell of tantalum is 3·2959 ± 0·0003 at 20° C. H. H.

Swjaginzew (O. E.) & Brunowsky (B. K.). *Über das Osmiridium I. (Röntgenographische Untersuchungen.)* Zeits. Krist., 1936, vol. 9 pp. 229–237, 6 figs.

Laue diagrams show that single crystals of osmiridium have fibrous structure, being divided into blocks inclined to each other angles of up to 10°. H. H.

Komovsky (G.) & Maximow (A.). *Röntgenographische Untersuchu des Zustandsdiagramms der AlLi-Legierung und die Struktur AlLi-Verbindung.* Zeits. Krist., 1935, vol. 92, pp. 275–28 4 figs.

The alloy AlLi occurs in two phases. The cubic unit cell of t β phase contains sixteen atoms and has an edge of length 6·37 Å. H. H.

McKeehan (L. W.). *Note on MgZn and $MgZn_5$.* Zeits. Krist., 19 vol. 91, pp. 501–503.

A criticism of L. Tarschisch's work [M.A. **5**–465]. H. H.

Helmholz (Lindsay). *The crystal structure of hexagonal silver iodi* Journ. Chem. Physics (Amer. Inst. Physics), 1935, vol. pp. 740–747, 2 figs.

Laue, powder, and oscillation photographs of artificial crystals AgI at – 180° C. show a close approximation to the wurtzite str ture with the ideal parameter value of 1/8. But at room-tempe ture the silver atoms are distributed at random among four positi tetrahedrally surrounding the ideal position in the wurtzite structu Anomalies in the physical behaviour of AgI are discussed in t connexion. L. J. S.

Schulze (Gustav E. R.). *Die Kristallstruktur von Radiumfluo* Zeits. Physikal. Chemie, Abt. B, 1936, vol. 32, pp. 430–432.

RaF_2 has the fluorite structure with a unit cell of edge *a* 6·368 containing four molecules; *d* 6·75. L. J. S.

ETELAAR (J. A. A.). *Die Kristallstruktur des Thallofluorids.* Zeits. Krist., 1935, vol. 92, pp. 30–38, 2 figs.

Thallium fluoride has the space-group V_{2h}^{23}. The unit cell contains ur molecules of TlF and has a 5·180, b 5·495, c 6·080 Å. H. H.

ARKER (David). *The crystal structure of cupric chloride dihydrate $CuCl_2.2H_2O$. Square quadricovalent cupric copper.* Zeits. Krist., 1936, vol. 93, pp. 136–145, 4 figs.

Cupric chloride has the space-group D_{2h}^{7}. The unit cell contains vo molecules of $CuCl_2.2H_2O$ and has a 7·38, b 8·04, c 3·72 Å.

H. H.

ATTA (G.). *Bemerkung zur Arbeit „G. Engel, Die Kristallstrukturen einiger Hexachlorokomplexsalze" (Z. Kristallogr. 90 (1935) 341).* Zeits. Krist., 1935, vol. 91, p. 370.

A claim for priority in measurement of the structures of salts of e K_2PtCl_6 type. [M.A. **6**–173.] H. H.

ANN (Frederick G.), CROWFOOT (Dorothy), GATTIKER (David C.), & WOOSTER (Nora). *The structure and configuration of certain diamminopalladium compounds.* Journ. Chem. Soc. London, 1935, pp. 1642–1652, 1 pl., 5 text-figs.

Rotation photographs of single crystals of the reddish-blue form diamminopalladium di-iodide show streaked spots on the odd yer-lines. The sharply defined spots indicating a perfectly regular ll structure are due to palladium atoms, whereas the streaks are used by irregular positions of the iodine atoms along the c-axis. he di-iodide (and to a lesser extent the dichloride) reveal in this ay a 'highly anomalous form of repeated polysynthetic twinning'. hemical, crystallographic, and X-ray data are also given for the red nd yellow dimorphous forms of *trans*-diamminopalladium dichloride; ale-yellow *cis*- and *trans*-dinitrites; yellow and reddish-blue forms the di-iodide; colourless *cis*-oxalate; tetramminopalladium pal-donitrite and palladoiodide. F. A. B.

ETELAAR (J. A. A.). *Die Kristallstruktur von K-, Rb-, Cs- und Tl-Silicofluorid und von $LiMnO_4.3H_2O$.* Zeits. Krist., 1935, vol. 92, pp. 155–156.

The salts $(NH_4)_2SiF_6$, K_2SiF_6, Rb_2SiF_6, Cs_2SiF_6, Tl_2SiF_6 are iso-orphic with K_2PtCl_6. Their cubic unit cell has an edge of length 337, 8·168, 8·446, 8·867, 8·563 Å. respectively. Lithium perman-nate ($LiMnO_4.3H_2O$) is isomorphic with $LiClO_4.3H_2O$ and has a exagonal unit cell with a 7·78, c 5·39 Å. H. H.

Ölander (Arne). *Zur Kristallstruktur von CdSb.* Zeits. Krist., 1935 vol. 91, pp. 243–247.

The orthorhombic unit cell of cadmium antimonide contains sixtee molecules of CdSb and has a 8·492, b 8·320, c 6·390 Å. H. H.

Palacios (J.) & Salvia (R.). *Estructura cristalina de la argentita de la acantita.* Anal. Soc. Española Fís. Quím., 1931, vol. 29 pp. 269–279.

Argentite and acanthite show the same powder photographs a temperatures below 180° C. indicating a mixture of cubic and ortho rhombic crystals, the cubic form being metastable; but above thi transition point only the cubic form is evident. The unit cel dimension of argentite is a 4·90 Å., and of acanthite a 4·77, b 6·92 c 6·88 Å. [Cf. M.A. **3**–338.] L. J. S.

Levi (G. R.) & Baroni (A.). *Strutture ed alterazioni di struttura d NiS e di NiSe.* Zeits. Krist., 1935, vol. 92, pp. 210–215, 6 figs

Nickel sulphide occurs in three modifications. α–NiS, obtained b precipitating with $(NH_4)_2S$, is amorphous. β–NiS, obtained fron acid solutions of the acetate, is identical with the usual syntheti hexagonal salt whose unit cell has a 3·42, c 5·30 Å. γ–NiS, obtaine from acid solutions of the sulphate, is identical with millerite, whos rhombohedral unit cell has a 9·61, c 3·15 Å. Nickel selenide ha three closely analogous forms, α–NiSe being amorphous, β–NiS identical with the usual synthetic salt (a 3·66, c 5·33 Å.), and γ–NiS isomorphic with millerite (a 9·84, c 3·18 Å.). H. H.

Kurz (Woldemar). *Chemisch-röntgenographische Untersuchung a „blauen Kupferglanz".* Zeits. Krist., 1935, vol. 92, pp. 408 434, 10 figs.

Chalcosine from many localities was analysed and subjected t X-ray analysis. The mineral contained from 24 to 33 % CuS i solution besides 1·6 to 3·3 % bornite, &c. The structure is that of supercooled cubic crystal with a unit cell having an edge of 5·55 Å very little altered by the dissolved covelline. H. H.

Goßner (B.). *Über Kristallform und molekulare Einheit von Nagyagi* Zentr. Min., Abt. A, 1935, pp. 321–327.

Nagyagite is tetragonal (or pseudo-tetragonal) with a unit cel a 12·5, c 30·25 Å., containing eight molecules of $6Pb(S,Te)_2.AuTe$ in which the Pb(S,Te) is partly replaced by Sb_2S_3. L. J. S.

ŏzu (Shukusuké) & Watanabé (Shinroku). *Morphological studies of enargite.* Proc. Imp. Acad. Tokyo, 1935, vol. 11, pp. 418–420, 5 figs.

ŏzu (Shukusuké) & Takané (Katsutoshi). *Re-examination of space group and cell dimensions of enargite.* Ibid., pp. 421–422.

Crystals of enargite from Kinkwaseki mine, Formosa, are usually ached at one end, doubly terminated crystals being rare. The ter show hollow ends with the basal plane at one end and a series pyramids and domes at the other. The crystals are therefore nimorphic and the space-group must be C_{2v}^7. New determinations ve a 6·41, b 3·69, c 6·14 Å. for the cell dimensions [M.A. **5**–467, 39]. L. J. S.

ioep (A.) & Billiet (V.). *Contribution à l'étude du réseau de la julienite* [$Na_2Co(CSN)_4.8H_2O$]. Zeits. Krist., 1935, vol. 91, pp. 229–234, 1 fig.

ulienite is identical with synthetic $Na_2Co(CSN)_4.8H_2O$. Its tetra- al unit cell contains one molecule and has a 9·22, c 5·56 Å. H. H.

: (P'ei-Hsiu). *The structure of α-quartz.* Zeits. Krist., 1935, vol. 92, pp. 355–362, 2 figs.

The structure of α-quartz was re-investigated in order to determine four parameter values, which prove to be $u = 167·5° \pm 1·5°$, $150° \pm 5°$, $y = 100° \pm 5°$, $z = 40° \pm 5°$, the space-group being D_3^4 D_3^6. H. H.

:uwenkamp (W.). *Die Kristallstruktur des Tief-Cristobalits SiO_2.* Zeits. Krist., 1935, vol. 92, pp. 82–88, 2 figs.

The space-group of the tetragonal pseudo-cubic cristobalite is 2_1. The unit cell contains eight molecules of SiO_2 and has 002, c 6·92 Å. H. H.

rk (George L.) & Reynolds (Dexter H.). *An X-ray diffraction method for the estimation of quartz in a mixture of silicate ores.* Univ. Toronto Studies, Geol. Ser. 1935, no. 38, pp. 13–22, 1 pl., 2 text-figs.

he amount of quartz present in specimens of mine dust has been rmined by a modified X-ray powder method. Powder photo- hs of mixtures of quartz and fluorite in known proportions form basis of comparison, the ratio of intensities of quartz and fluorite s being plotted with the percentage of quartz. By adding a

known amount of fluorite to a given weight of the sample dust th corresponding intensity ratio yields the percentage of quartz in th sample to an accuracy of 10 %. F. A. B.

Burton (E. F.) & Oliver (W. F.). *The crystal structure of ice at lo temperatures.* Proc. Roy. Soc. London, Ser. A, 1935, vol. 15 pp. 166–172, 1 pl., 1 text-fig.

X-ray photographs of ice formed by the condensation of vapou at low temperatures and pressures show that below −110° C. th material is vitreous, whilst above this temperature it is sem crystalline or crystalline. L. J. S.

Aminoff (G.) & Broomé (B.). *Oxidation of single crystals of zi sulphide studied by electron diffraction.* Nature, London, 193 vol. 137, p. 995, 3 figs.

The iridescent film produced on crystals of blende when heated air gives a hexagonal pattern of ZnO with the *c*-axis perpendicul to an octahedral face and an *a*-axis parallel to an octahedral edge. L. J. S.

Verwey (E. J. W.). *The structure of the electrolytical oxide layer aluminium.* Zeits. Krist., 1935, vol. 91, pp. 317–320.

The thin oxide layer formed by the electrolytic oxidation of aluminium electrode is sometimes amorphous and sometimes cryst line in the cubic system. The relation of the latter form to the cub γ-Al_2O_3 is discussed. H. H.

Verwey (E. J. W.) & Bruggen (M. G. van). *Structure of solid sol tions of Fe_2O_3 in Mn_3O_4.* Zeits. Krist., 1935, vol. 92, pp. 13 138, 1 fig.

A diagram shows the manner in which the tetragonal structu of Mn_3O_4 passes into the spinel structure of $Mn_3O_4.3Fe_2O_3$ as the ra of Fe to Mn increases. H. H.

Kordes (Ernst). *Kristallchemische Untersuchungen über Aluminiu verbindungen mit spinellartigem Gitterbau und über γ-Fe_2O_3. M einem Beitrag über die mineralisatorische Wirkungsweise Fluoriden.* Zeits. Krist., 1935, vol. 91, pp. 193–228, 3 figs.

A spinel $LiAl_5O_8$ was synthesized, whose properties are very simi to those of the spinel $Mg_2Al_4O_8$ and which forms mixed crystals w this magnesium spinel. The unit cell of the lithium spinel has ed 7·903 Å. Well-crystallized γ-Al_2O_3 was obtained from fused lithi

phosphate. Its physical properties practically agree with those of $LiAl_5O_8$, and it has a spinel structure with a unit cell of edge 7·895 Å. Its stability is increased by small quantities of Li_2O and H_2O. Probably FeO and H_2O act similarly in increasing the stability of the ferromagnetic γ-Fe_2O_3 whose properties are compared with those of γ-Al_2O_3. H. H.

Sedlitz (O.). *Über Translationsgitter und Gitterkonstante des Spinell.* Zeits. Krist., 1936, vol. 93, pp. 316–317.

It is contended that the proposal of E. Kordes (preceding abstract) to double the lattice constants of spinel is unjustified. H. H.

Bernal (J. D.), Djatlowa (E.), Kasarnowsky (I.), Reichstein (S.), & Ward (A. G.). *The structure of strontium and barium peroxides SrO_2 and BaO_2.* Zeits. Krist., 1935, vol. 92, pp. 344–354, 2 figs.

Strontium and barium peroxides have the space-group D_{4h}^{17} and the calcium carbide structure with four molecules in the unit cell. The size of the cell is a 5·02, c 6·55 Å. for SrO_2, and a 5·34, c 6·77 Å. for BaO_2. H. H.

Bystrecov (K.). *On the structure of zinc hydroxide.* Zeits. Krist., 1935, vol. 91, p. 505.

A discussion of discrepancies in the work of Corey and Wyckoff [M.A. **5**–471], Fricke (Zeits. Anorg. Chem., 1927, vol. 166, p. 244), Gottfried and Mark [M.A. **3**–430], and Megaw [M.A. **6**–176]. H. H.

Weiser (Harry B.) & Milligan (W. O.). *X-ray studies on the hydrous oxides. V. Beta ferric oxide monohydrate.* Journ. Amer. Chem. Soc., 1935, vol. 57, pp. 238–241, 3 figs.

The yellow precipitate obtained when dilute solutions of ferric chloride are heated, formerly supposed to be a basic chloride, is actually a third polymorph of FeO.OH, designated β. It is orthorhombic, with a 5·28, b 10·28, c 3·34 Å., and 4 mols. FeO.OH per unit cell; sp. gr. 3·2. On continued heating with water, or when heated alone to 150–200° C., it passes into haematite. M. H. H.

Weiser (Harry B.) & Milligan (W. O.). *X-ray studies on the hydrous oxides. VII. Ferric oxide.* Journ. Physical Chem., 1935, vol. 39, pp. 25–34, 4 figs.

The primary gel obtained from ferric salts and bases in the cold is amorphous; on ageing it gradually passes into α-Fe_2O_3 [haematite]. Hydrolysis of ferric salts other than the chloride gives α–Fe_2O_3 if

rapid, α-FeO.OH [goethite] if slow, but the sulphate may give basi sulphates. The ferric oxide gels formed by hydrolysis of $Fe(OC_2H_5)$ show no breaks indicative of definite hydrates on dehydration. [C M.A. **5**–105–107.] M. H. H.

Pauling (Linus). *The unit of structure of telluric acid, Te(OH)* Zeits. Krist., 1935, vol. 91, pp. 367–368, 1 fig.

A rotation photograph is given to prove that the unit cell contain 32 molecules, and not 4, as stated by Gossner and Kraus [M.A. **6**–43 H. H.

Billiet (V.) & Jong (W. F. de). *Schoepiet en becquereliet.* Natuu wetenshappelijk Tijdschrift, Gent, 1935, vol. 17, pp. 157–16 2 pls. (Flemish with French résumé.)

Rotation and powder photographs give unit cells for schoepit *a* 14·40, *b* 16·89, *c* 14·75 Å. ($a:b:c = 0{\cdot}852:1:0{\cdot}873$), and for be querelite *a* 13·9, *b* 12·55, *c* 14·9 Å. ($a:b:c = 1{\cdot}107:1:1{\cdot}187$). The values are not concordant with the specific gravity and chemic formulae previously given. New determinations of sp. gr. ga 4·83 and 5·20 respectively; and the chemical formulae deduced fro these values are for schoepite $4UO_3.9H_2O$, and for becquereli $2UO_3.3H_2O$. [M.A. **5**–336; **6**–90.] L. J. S.

Kordes (Ernst). *Die Steinsalzstruktur der Verbindung Li_2TiO_3 u ihre Mischkristallbildung mit MgO und $Li_2Fe_2O_4$.* Zeits. Krist 1935, vol. 92, pp. 139–153, 2 figs.

Lithium titanate has the rock-salt structure, the unit cell havi $1\frac{1}{3}$ molecules of Li_2TiO_3 and edge 4·1355 Å. It forms with Mg a continuous series of mixed crystals. Mixed crystals of MgO–Li_2Fe_2O Li_2TiO_3–$Li_2Fe_2O_4$, MgO–Li_2TiO_3–$Li_2Fe_2O_4$ were also investigate They all have the rock-salt structure and their lattice constants a obtained by simple addition from those of the component substance H. H.

Barnick (Max). *Strukturuntersuchung des natürlichen Wollastonit* Naturwissenschaften, 1935, vol. 23, pp. 770–771.

Wollastonite from Cziklova, Banat, is shown to be definite monoclinic with *a* 15·33, *b* 7·28, *c* 7·07 Å., β 84° 35½′ and 12 mol cules $CaSiO_3$ in the unit cell. The space-group is C_{2h}^5, and the structu is built up of Si_3O_9 rings. L. J. S.

HATSCHKI (F.). *Thortveitit und Magnesiumpyrophosphat.* Fortschr. Min. Krist. Petr., 1936, vol. 20, pp. 47–49.

$Mg_2P_2O_7$ gave cell dimensions a 13·28 (= 2 × 6·64), b 8·36, c 9·06 (2 × 4·53) Å., β 75° 49′. These are compared with those of thortveitite $Sc_2Si_2O_7$, a 6·56, b 8·58, c 4·74 Å., β 76° 52′ [M.A. **5**–111, 280]. L. J. S.

UNZ (Hugo). *Datolith und Herderit. Ein Beitrag zur Kenntnis der Isomorphie zwischen Silikaten und Phosphaten.* Zeits. Krist., 1936, vol. 93, pp. 146–150, 1 fig.

Herderite has the space-group C_{2h}^5. The unit cell contains four molecules of $Ca(F,OH)BePO_4$ and has a 4·80, b 7·68, c 9·80 Å., 0° 54′. Herderite is isomorphous with datolite $Ca(OH)BSiO_4$. H. H.

NER (B.) & DREXLER (K.). *Über Kristallform und chemische Zusammensetzung von Lamprophyllit.* Zeits. Krist., 1935, vol. 91, pp. 494–500.

amprophyllite from Kola has density 3·45. The orthorhombic cell contains four molecules of $(SiO_4)_2TiSrNa_2$ and has a 19·05, 05, c 5·35 Å. H. H.

NER (John W.). *The structural relationship of glauconite and mica.* Amer. Min., 1935, vol. 20, pp. 699–714, 1 fig.

lauconite (d 2·855) from Bonneterre, Missouri, previously analysed A. **3**–311] gave a unit cell a 5·25, b 9·10, c 19·96 Å., β 85°, in e agreement with material from five other localities, and also analysed biotite from Mora, Minnesota [M.A. **3**–53], the values the latter being a 5·33, b 9·23, c 20·11 Å., β 85°. The glauconite cture is still stable at 750° C. and in water containing a little F at 300°. Boiling thallium nitrate solution replaces up to % of the K ions. The formula of glauconite and its relation to of mica are discussed; the unit cell of the analysed specimen n Bonneterre contains

$$(OH)_{6-8}K_3(Mg, Fe'', Ca)_{2\cdot7}(Fe''', Al, Si)_{4\cdot8}(Si_{13}Al_3)O_{38-39}.$$

L. J. S.

NER (B.). *Über Cronstedtit von Kisbánya.* Zentr. Min., Abt. A, 1935, pp. 195–201.

emispherical aggregates of crystals of cronstedtite terminated by ngular basal planes are grown on chalybite and pyrite from bánya, Hungary [= Chiuzbaia, Satu Mare, Romania]. The crystals

are hemimorphic and piezoelectric. Sp. gr. 3·445. X-ray measu ments gave a unit cell a 5·48, b 9·45, c 7·08 Å. Analysis gave Si 16·42, Al_2O_3 0·90, Fe_2O_3 29·72, FeO 41·86, CaO 1·32, H_2O 10·17 100·39, which is expressed as an isomorphous mixture of 80 % $Si_2Fe'''_4Fe''_4O_{10}(OH)_8$ (ferroamesite) and 20 % of $Si_4Fe''_6O_{10}(OH$ (ferroantigorite), with one such molecule in the unit cell. T mineral shows differences from chlorite. For clinochlore fr Achmatovsk, Ural, the unit cell is a 5·34, b 3·27, c 14·15 Å.

L. J. S.

Nagelschmidt (G.). *On the lattice shrinkage and structure of mo morillonite.* Zeits. Krist., 1936, vol. 93, pp. 481–487, 1 fig.

The $d_{(001)}$ spacing of montmorillonite shows a proportional increa from 10·5 to nearly 15 Å. during the uptake of the first four mo cules of water per $Al_4Si_8(OH)_4O_{20}$, but only a slight increase of 0·6 during the uptake of the next ten molecules, which probably rema at the surfaces of the crystals. The spacing rises to nearly 19 when still more water is added. H. H.

Lipson (H.). *The relation between the alum structures.* Proc. R Soc. London, Ser. A, 1935, vol. 151, pp. 347–356, 4 figs.

Three different structures are found for rubidium-alum, caesiu alum, and sodium-alum. [Cf. M.A. **6**–182.] L. J. S.

Waldo (A. W.). *X-ray powder diffraction data for antlerite a brochantite.* Amer. Min., 1936, vol. 21, pp. 71–73.

Corrections to a previous paper [M.A. **6**–167]. L. J. S.

Klasens (H. A.), Perdok (W. G.), & Terpstra (P.). *The cryst lography of magnesiumsulphite.* Rec. Trav. Chim. Pays-B 1935, vol. 54, pp. 728–732, 4 figs.

Crystals of $MgSO_3.6H_2O$ (not $3H_2O$) are trigonal hemimorphic w $a : c = 1 : 1·0287$ and are piezoelectric; sp. gr. 1·725, ω 1·511, ϵ 1·4 The hexagonal unit cell, a 8·820, c 9·041 Å., contains three molecul or a rhombohedral unit cell, a 5·917 Å., α 96° 22′, one molecu The space-group is C_3^4. L. J. S.

Kraus (O.). *Untersuchungen über das Kristallgitter von Heteropo säuren und deren Salzen. 1. Mitteilung. Das Gitter von Kies wolframsäure, Borwolframsäure und Ammoniumborwolfram* Zeits. Krist., 1935, vol. 91, pp. 402–409.

$H_5BW_{12}O_{40}.31H_2O$ has the space-group D_{4h}^6. The unit cell conta two molecules and has a 12·83, c 18·38 Å. $(NH_4)_5BW_{12}O_{40}.26H$

the same space-group, while the unit cell contains two molecules has a 12·80, c 18·40 Å. $H_4SiW_{12}O_{40}.31H_2O$ has a similar lattice a 12·98, c 18·52 Å. H. H.

US (O.). *Untersuchungen über das Kristallgitter von Heteropolysäuren und deren Salzen. 2. Mitteilung. Die Konstitution der Silicowolframate dreiwertiger Metalle.* Zeits. Krist., 1936, vol. 93, pp. 379–395, 5 figs.

luminium silico-tungstate has the space-group D_{3d}^5; the unit contains two molecules of $AlHSiW_{12}O_{40}.28H_2O$ and has a 15·56, ·35 Å. Iron silico-tungstate has the space-group D_{3d}^5; the unit contains two molecules of $FeHSiW_{12}O_{40}.28H_2O$ and has a 15·60, ·36 Å. Chromium silico-tungstate has the space-group D_{3d}^5; the cell contains two molecules of $CrHSiW_{12}O_{40}.28H_2O$ and has ·58, c 41·32 Å. Other silico-tungstates were also measured for h the amount of water of crystallization is uncertain, though probably are of the type $RHSiW_{12}O_{40}.24H_2O$. H. H.

HERJEE (P. L.). *On the isomorphism of the double fluoberyllates with the Tutton salts.* Zeits. Krist., 1935, vol. 91, p. 504.

space-group of $(NH_4)_2Ni(BeF_4)_2.6H_2O$ and $(NH_4)_2Ni(SO_4)_2.6H_2O$ The unit cell contains two molecules, and has a 9·04, b 12·31, Å., β 73° 20′, and a 8·98, b 12·22, c 6·10 Å., β 72° 56′ respectly. H. H.

T (C. D.). *Crystal structures of hydrated compounds. II. Structure type $Mg(ClO_4)_2.6H_2O$.* Zeits. Krist., 1935, vol. 91, pp. 480–493, 3 figs.

he structure and physical constants of the hydrated perchlorates fluoborates of Li, Na, Ag, Mg, Mn, Fe, Co, Ni, Cu, Zn, Cd, Hg given. The typical magnesium perchlorate has the space-group Its unit cell contains two molecules of $Mg(ClO_4)_2.6H_2O$ and has $a' = a/2 = 7·76$, $b' = a'\sqrt{3} = 13·46$, $c' = c = 5·26$ Å. H. H.

DER (W.). *Über den Bau einiger Hydrate von Natriumdiborat.* Zeits. Krist., 1935, vol. 92, pp. 301–309.

he space-group of kernite is C_{2h}^4. The unit cell contains four ecules of $Na_2B_4O_7.4H_2O$ and has a 6·96, b 9·4, c 15·52 Å., β 71° 8′. space-group of tincalconite is probably C_{3i}^2; the rhombohedral cell contains three molecules of $Na_2B_4O_7.5H_2O$ and has a 9·56 A., ° 42′. The space-group of borax (tincal) is C_{2h}^6; the unit cell

contains four molecules of $Na_2B_4O_7.10H_2O$ and has a 11·82, b 10·6 c 12·30 Å., β 73° 25′. H. H.

Levi (G. R.) & Peyronel (G.). *Struttura cristallografica del grup isomorfo* (Si^{4+}, Ti^{4+}, Zr^{4+}, Sn^{4+}, Hf^{4+})P_2O_7. Zeits. Krist., 193 vol. 92, pp. 190–209, 5 figs.

The pyrophosphates of Si, Ti, Sn, Zr, Hf crystallize in the spac group T_h^6. The cubic unit cell contains four molecules and has edge of 7·46, 7·80, 7·89, 8·20, 8·18 Å. respectively. H. H.

Pitzer (K. S.). *The crystal structure of tetramminocadmium perrhena* $Cd(NH_3)_4(ReO_4)_2$. Zeits. Krist., 1935, vol. 92, pp. 131–13 2 figs.

Tetrammino-cadmium perrhenate has the space-group T_d^2. T unit cell contains four molecules of $Cd(NH_3)_4(ReO_4)_2$ and has a 10·35 H. H.

Miscellaneous.

[Boldyreva (A. M.)] Болдырева (А. М.). Гидроборацит и иньоит Индерских гор (западный Казакстан).—Boldyreva (A. M *Hydroboracite and ynyoite of Indersky Mountains* (*western Kaza stan*).—материалы Центрального Научно-исследовтельского Ге лого-Разведочного Института (Materials Central Sci. Geol. a Prospecting Inst.), 1936, no. 1, pp. 62–65. (Russian with Engli summary.)

A large deposit of borates has recently been discovered at th locality in SW. Siberia. Hydroboracite ($CaMgB_6O_{11}.6H_2O$) occu as fine stellate aggregates of long colourless needles (anal. I) wi two cleavages and H. 2; and as compact and fine-grained mass (anal. II) with H. 3. Both varieties are readily soluble in aci but are only partly dissolved by prolonged boiling in water; α 1·52 β 1·534, γ 1·569, 2V 66°, positive. Inyoite ($Ca_2B_6O_{11}.13H_2O$) colourless and transparent (anal. III) with two cleavages, H. α 1·492, β 1·505, γ 1·516, 2V 84°, negative. In hot water it fi becomes opaque and on boiling is completely dissolved.

	B_2O_3.	SiO_2.	Al_2O_3.	Fe_2O_3.	MgO.	CaO.	Alkalis.	H_2O.	CO_2.	Tot
I.	46·79	0·36	0·22	0·30	9·88	14·96	nil	25·59	1·37	99·
II.	49·04	0·33	0·38		9·84	13·63	0·15	25·45	1·65	100·
III.	36·26	0·11	0·15		trace	20·80	0·17	42·31	nil	99·

I, also MnO, Cl traces, SO_3 nil.

L. J. S.

HE MINERALOGICAL MAGAZINE
AND
JOURNAL OF
THE MINERALOGICAL SOCIETY

. 154 September, 1936 Vol. XXIV

Eulysites and related rock types from Loch Duich, Ross-shire.

By C. E. Tilley, Ph.D., B.Sc.
rofessor of Mineralogy and Petrology, University of Cambridge.

[Read January 30, 1936.]

UR knowledge of the rare rock type eulysite (A. J. Erdmann, 1846) comes almost wholly from Swedish occurrences and hither- no examples have been recognized from Britain. It is therefore nterest to place on record a new occurrence of eulysites and related ks from among Lewisian rocks of the Glenelg area, Scotland.

The rocks shortly to be described come from the vicinity of Totaig Loch Duich between Totaig and Letterfearn, little more than half mile from the first described occurrence of eclogite in Britain.[1] se eulysitic rocks crop out on the hillside immediately south-west Druideig Lodge. About 200 yards south-west of the lodge coarse net-paragneisses form outcrops associated with grunerite- and nmingtonite-garnet-gneisses, and a similar interbanded association ound at higher levels. At the summit of the knoll, darker and e massive rock types, consisting chiefly of pyroxene-garnet- gnetite and fayalite-pyroxene-garnet-magnetite assemblages vily stained with black hydrated oxide of manganese, are de- pped.

The paragneisses of this area form part of the broad band of meta- phosed argillaceous sediments which accompany the bands of

[1] J. J. H. Teall, On an eclogite from Loch Duich. Min. Mag., 1891, vol. 9, 7.

Glenelg limestone—striking NNE. towards Loch Duich betw Totaig and Letterfearn. The general characters of the paragneis in the area have been described by Clough in the Survey Memoir.

South-west of Druideig Lodge the garnet-gneisses form strikin coarse aggregates chiefly of garnet and quartz. Microscopically tl are seen to be composed of garnet, quartz, oligoclase, biotite, a muscovite, while Clough has recorded examples containing c spicuous kyanite. The garnets of the coarser types are seen to b process of replacement by chlorite. It is with these typical pa gneisses that the rocks of eulysitic facies now to be described occ

These iron-rich rocks may be divided into three groups accord to their mineralogical contents:

(1) Eulysites proper containing abundant fayalite.

(2) Hedenbergite-garnet-rocks.

(3) Grunerite-garnet-rocks.

(1) *Eulysites.*—The eulysites proper are massive rocks of h density (4·0) often conspicuous in the field by their bluish-bl weathering surfaces, the colour being due to hydrated oxide of m ganese. Fresh fractured surfaces are dark and somewhat resin lustred, due to the abundance of fayalite which under a low-po lens is seen to have in thin flakes a honey-yellow colour. In granular matrix of fayalite occur larger dark green-black crystals pyroxene, whilst granular red garnet and magnetite are sporadica distributed.

Under the microscope, the constituents seen are fayalite, hedenb gite, iron-hypersthene, garnet, magnetite, and apatite. Some gru rite of secondary development may appear in some of the roc The chief constituents, fayalite and pyroxene, form granobla aggregates and seldom show good crystal shape. The fayalite ($\frac{1}{2}$ m average grain-size) shows fair (010) and poor (100) cleava Lamellar twinning of the type familiar in magnesian olivine is uncommon. The low optic axial angle and pale yellow colour sh that this mineral is near fayalite in composition, but the high cont of MnO in the analysis of the rock makes evident further that it *manganfayalite*. A feature which is characteristic of these and ot eulysites is the aggregation of magnetite grains fringing the faya crystals.

Monoclinic pyroxene is readily distinguished among the faya aggregates by its lower relief, light green colour and more per

[1] Geology of Glenelg, Mem. Geol. Surv. Scotland, 1910, p. 26.

avage. The grain-size is more variable and may reach in por-yroblasts a diameter of 3 mm. or more. A fine salite striation is t uncommon and magnetite dendrites are not infrequently present the larger crystals.

An iron-rich hypersthene forming independent grains associated h fayalite and monoclinic pyroxene appears in significant amounts some of the eulysites. The properties of this hypersthene are erred to on p. 334.

The garnets (spessartine-almandine) are conspicuous by a charac-istic yellow-pink tinge. Less abundant than either fayalite or roxene, they show considerable variation in grain-size ($\frac{1}{2}$ – 3 mm.) l are xenoblastic. Enclosures are few but include magnetite, atite, and less frequently fayalite and pyroxene.

Magnetite, like garnet, is uneven in its distribution. It may be centrated in narrow zones giving in places a banded structure to rock. In these it forms xenoblastic grains wrapping around alite or intergrown with garnet. That this banding expresses inal compositional differences is suggested by a like orientation ands with variable pyroxene and fayalite contents.

Grunerite can usually be detected in small amount and in some mples is conspicuous. It is readily distinguished by its almost urless appearance in thin section, fibrous character, and multiple twinning. Its secondary development is made clear from the urrence of it in veins and the manner of its development from noclinic pyroxene, and also from fayalite.

typical member of these eulysites has been analysed (table I, 1). The rock contains, in order of abundance, fayalite, hedenber-including some iron-hypersthene, magnetite and garnet, apatite. ypical section of this rock is illustrated in fig. 1 *b*. The notable ure of this analysis is the high MnO content (12·55 %) and high of iron oxides (40·33 %). Rocks of comparable chemical com-tion are indicated in the table, but a discussion of these analyses eferred to a later page (p. 340).

ulysitic rocks rich in iron-hypersthene.—Iron-hypersthene has been ady referred to under the description of the eulysites. A few s, however, contain it in abundance. The mineral is present in ciation with fayalite or with monoclinic pyroxene, and in one —a hypersthene-grunerite-garnet type—it forms the major con-ent.

specimen no. 221 it forms independent grains as well as parts of

zoned crystals of porphyroblastic monoclinic pyroxene. In these th orthorhombic mineral may appear as irregular areas within the por phyroblast or form an outer shell. Some of the monoclinic pyroxen has the distinctive properties of an enstatite-augite, with 2V smal positive, and low double refraction; but a hedenbergitic variety wit the characteristics of the pyroxene of the eulysites is also presen This occurrence of an enstatite-augite is comparable with the exampl recorded by Geijer[1] among the eulysites of north Sweden.

Another rock (no. 50) is a coarse-grained type built up of hype sthene with small amounts of grunerite and garnet. Crystals hypersthene reach up to 6–10 mm. in length and have fine schill plates of brown translucent ilmenite. The rock has been subject stress with the development of fine lamellar twinning in the hype sthene. Between the large plates of hypersthene occur granulit zones of finer-grained orthorhombic pyroxene (fig. 2 *b*). There are a fe scattered grains of green hedenbergitic pyroxene and manganifero garnet. Grunerite occurs in veins and bands replacing the iro hypersthene, and it appears clear that eventually a grunerite-ro might well develop from a rock of this type.

The pyroxene of this rock has been subject to analysis and account of its composition and optical properties has recently be published.[2] The mineral contains FeO 35·39, MnO 6·29, and Mg 7·02 %; optically negative, 2V 68°, α 1·738, β 1·749, γ 1·755.

(2) *Hedenbergite-garnet-magnetite rocks.*—Like the eulysites prop these rocks are also manganiferous and yield on weathered surfac a blue-black crust. On fresh fractures the rocks are dark-colour with conspicuous pyroxene like that of the eulysites, magnetite, a pink garnet. The last may give, as in the eulysites, a faint band character to parts of the rock, though this is seldom conspicuous.

Under the microscope, the chief constituents are seen to be hed bergite, magnetite, garnet, and apatite. Fayalite is present in so examples and with it a link between these rocks and the eulysi proper is established. Iron-hypersthene and secondary grunerite also developed.

The pyroxene is a green hedenbergite with a characteristic sal striation. The grain-size is variable, porphyroblasts up to 4 mm. diameter being associated with aggregates of smaller crystals

[1] P. Geijer, Årsbok Sveriges Geol. Undersökning, 1925, ser. C, no. 324 1923), pp. 4 and 9.

[2] N. F. M. Henry, Min. Mag., 1935, vol. 24, p. 221.

$\frac{1}{2}$ mm. diameter. That it is a hedenbergitic type is made clear m the optical properties $\gamma : c = 48°$, $\gamma = 1{\cdot}740$, and the paucity of mina in the rock analyses. Garnet is in xenoblasts with the same

TABLE I.

	1.	2.	3.	4.	5.	6.	7.	8.
...	32·85	38·12	37·06	33·30	46·46	46·12	49·43	48·8
...	0·20	0·03	0·16	0·36	—	nil	nil	—
O_3 ...	3·02	2·01	0·80	4·24	0·24	0·56	nil	—
O_3 ...	9·88	1·10	3·01	23·62	0·64	6·44	8·16	—
...	30·45	24·00	46·36	28·58	26·28	30·93	30·52	43·9
...	12·55	20·29	5·01	0·38	0·21	—	0·17	—
... ...	5·84	5·80	4·37	2·25	3·10	5·35	4·77	—
... ...	3·95	7·87	2·47	0·63	1·87	nil	0·18	—
...	trace	0·11	0·37	0·67	—	nil	nil	—
... ...	trace	0·16	0·30	0·65	—	nil	nil	—
+ ...	nil	0·18	0·20	4·03	1·15	6·13	6·24	7·3
− ...	0·30	—	—	1·24	0·07	1·34	0·51	—
... ...	0·78	0·44	0·38	0·42	0·13	nil	—	—
... ...	—	—	—	—	19·96	nil	0·43	—
... ...	—	0·10	0·08	0·13	0·11	0·38	—	—
	99·82	100·21	100·57	100·50	100·22	99·85*	100·41	100·0
GT. ...	4·034	3·95	4·212	3·316	—	—	2·87	—

Eulysite, Druideig Lodge, Loch Duich, Ross-shire. Analyst, W. H. Herds-

Eulysite, Stora Utterwicks Hage, Tunaberg, Sweden. J. Palmgren, Bull. . Inst. Upsala, 1917, vol. 14, p. 196. [M.A. 1–252.]

Eulysite, Mansjö Mt., Loos, Sweden. H. von Eckermann, Geol. För. Förh. kholm, 1922, vol. 44, p. 254. [M.A. 1–396.]

Magnetite-stilpnomelane-rock ('Schwarzfels'), Trondhjem region, Norway. . Carstens, Geol. För. Förh. Stockholm, 1924, vol. 46, p. 248.

Cherty iron carbonate rock (Gunflint beds), north side of Gunflint Lake, nesota. R. D. Irving and C. R. Van Hise, Monogr. U.S. Geol. Surv., 1892, 9, p. 192.

Greenalite-rock, Cincinnati mine, Mesabi district, Minnesota. C. K. Leith, ogr. U.S. Geol. Surv., 1903, no. 43, p. 108. *The total includes also insoluble $O_3 + Fe_2O_3$) 2·60.

Greenalite-rock, Biwabik, Mesabi iron range, Minnesota. F. Joliffe, Amer. , 1935, vol. 20, p. 416.

Greenalite (and metagreenalite). Calculated composition. F. Joliffe, ibid., 8. [M.A. 6–151.]

e as in the garnet of the eulysites, pointing to a manganiferous andine. Magnetite is an important constituent forming irregular ns wrapping around the pyroxenes. These rocks usually carry erite, which is often clearly secondary after pyroxene. The erial is always much lighter coloured than the pyroxene; optic- negative, γ 1·690, $\gamma : c = 15°$.

An analysis has been made of one of these rocks with the results given in table II, col. 1. This rock contains, in addition to pyroxene (hedenbergite), garnet, magnetite, and apatite, some iron-hypersthene and fayalite, as well as a small amount of secondary grunerite.

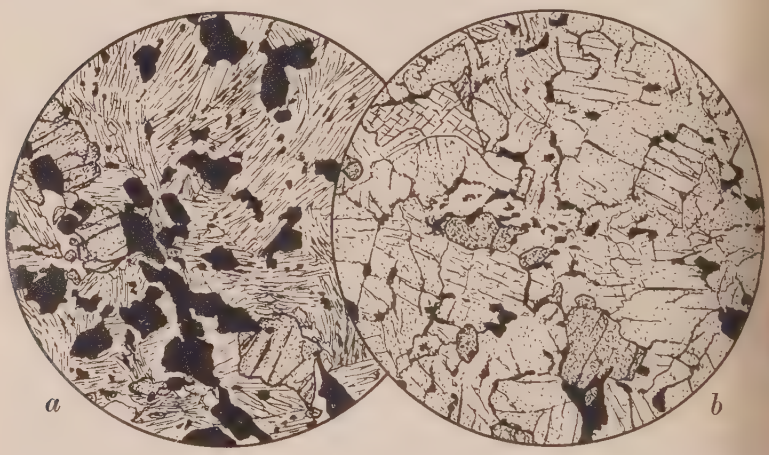


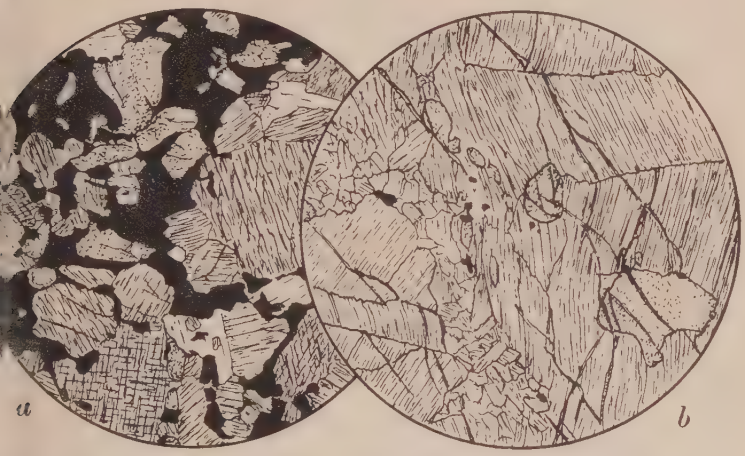
Fig. 1. *a*. Grunerite-garnet-magnetite-schist, Druideig Lodge. *b*. Eulysite, Druideig Lodge, showing fayalite, garnet, hedenbergite, and magnetite. ×20.

Hedenbergite is the most abundant constituent. A section of this rock is illustrated in fig. 2 *a*. Analysis shows again a high MnO content (7·5 %). Among the Swedish occurrences the most comparable analysis is that of a pyroxene-rich eulysite from Tunaberg (table I, col. 2). This has CaO 7·87 %. In table II the Loch Duich rock is compared with an average analysis of a Lake Superior cherty iron carbonate sediment.

(2 *a*) *Grunerite-garnet-magnetite-rocks with residual pyroxene.*—Associated with the pyroxene-garnet-rocks just described there occur types rich in grunerite but bearing a green pyroxene. These are dark dense-grained rocks in which pyroxene porphyroblasts are still visible, but the groundmass contains much grunerite. The production of grunerite at the expense of hedenbergite is best seen in the porphyroblasts themselves.

Irregular fragments of pyroxene are set in a matrix of fibrous grunerite. Ultimately pyroxene completely disappears and its place is taken by a divergent aggregate of grunerite grains occupying the space of former pyroxene.

In the groundmass the evidence of secondary development is not clear. The grunerite appears often as idioblastic grains without n of direct replacement. Nevertheless the strong evidence dis-ayed in the porphyroblasts and that of the cross-cutting veins



ig. 2. *a*. Hedenbergite-garnet-magnetite-rock, Druide. ʒ Lodge. *b*. Iron-ersthene-garnet-grunerite-rock, Druideig Lodge, showing zones of granulitic ersthene between larger stressed crystals of the same mineral. ×20.

ough the eulysitic rocks suggest that grunerite formation is subse-ut to that of pyroxene and eventually at its expense.

n these rocks, therefore, is to be traced a succession of stages from edenbergite-garnet-magnetite assemblage to one in which the last es of pyroxene are disappearing, and a corresponding removal of e during the transformation.

3) *Grunerite-(cummingtonite)-garnet-schists.*—Rocks bearing gruner- without pyroxene come under this category. They show some iety of appearance and composition. In the first place, they are e common than the eulysitic and pyroxenic types, and occur in ociation with the garnet paragneisses at lower levels on the hill- above Druideig Lodge.

n hand-specimens they appear as a rule as coarser-grained rocks the eulysites and the dominant amphibole varies much in colour a light clove-brown (cummingtonite) to dark green or black nerite). The lighter coloured amphiboles are cummingtonitic, tive in double refraction; the darker, gruneritic and negative in

sign. Magnetite is a very variable constituent, but is more abunda in the gruneritic types. Quartz, a mineral conspicuous by its abse from the eulysites, appears often here as an interstitial constituen

Table II.

	1.	2.
SiO_2	34·80	42·89
TiO_2	0·20	trace
Al_2O_3	3·82	0·12
Fe_2O_3	18·60	2·03
FeO	19·70	18·45
MnO	7·50	0·25
MgO	4·34	7·07
CaO	10·02	8·16
Na_2O	trace	—
K_2O	trace	—
H_2O+	0·25	1·45
H_2O-	0·15	
P_2O_5	0·78	0·09
CO_2	nil	19·20
&c.	—	0·13
	100·16	99·84
Sp. gr.	3·854	—

1. Hedenbergite-garnet-magnetite-rock, Druideig Lodge, Loch Duich, R shire. Analyst, W. H. Herdsman.

2. Average ferrous carbonate rock, Gunflint, Minnesota. C. Zappfe, E Geol., 1912, vol. 7, p. 162.

A short description of a rock selected for analysis (table III, col will give the essential petrography of this group of rocks. Grune forms long prisms reaching 2–3 mm. in length. Greyish to colour in section, it shows abundant multiple twinning on (100). mineral is optically negative and has an extinction $\gamma : c = 15°$. T forms the major constituent; magnetite is next in abundance, follo by garnet, quartz, and apatite. Xenoblastic garnet has the cha teristic yellowish-pink tinge of the manganiferous varieties (fig. 1

The analysis shows considerable similarity to that of the euly of table I, col. 1, both in its low lime content and sum of i oxides + MnO + MgO. A much higher Fe_2O_3 content of the grune rock is due to the larger content of magnetite.

In table III the rock is compared with a cummingtonite-gar schist from the Loch Maree area. This rock is also a manganife type and is tentatively referred to in the Survey Memoir as an alte manganiferous sediment. It is of interest to note that this r like the Loch Duich rock, is also involved in the Lewisian.

While the grunerite-rocks with residual pyroxene and massive texture give clear evidence of their origin, the rocks referred to here show no signs that they were at any time pyroxenic types. Their

TABLE III.

	1.	2.	3.	4.	5.	6.
SiO_2 ...	37·00	51·89	49·70	46·94	46·25	37·11
TiO_2 ...	0·18	—	—	—	—	0·22
Al_2O_3 ...	2·82	7·21	1·35	0·66	0·92	2·41
Fe_2O_3 ...	20·61	2·36	3·10	4·51	30·62	17·51
FeO ...	19·44	18·68	37·19	33·72	16·92	26·13
MnO ...	5·93	7·08	0·93	0·31	1·01	1·21
MgO ...	8·79	9·18	5·72	6·64	2·13	3·70
CaO ...	2·55	0·93	0·68	3·22	1·69	0·75
Na_2O ...	trace	0·31	trace	0·16	—	0·09
K_2O ...	trace	0·81	—	—	—	0·62
H_2O+ ...	1·20	1·33	1·40	0·67	0·42	2·57
H_2O- ...	0·30				—	0·95
P_2O_5 ...	1·27	—	0·12	0·07	0·07	0·09
CO_2... ...	nil	—	—	2·79	—	6·16
&c.	—	0·54	—	—	—	0·73
	100·09	100·32	100·19	99·69	100·03	100·25
Sp. gr. ...	3·582	3·38	—	—	—	—

1. Grunerite-garnet-magnetite-rock, Druideig Lodge, Loch Duich, Ross-shire. Analyst, W. H. Herdsman.

2. Cummingtonite-garnet-schist, $\frac{5}{12}$ mile SW. of outlet of Loch Bad-na-Sgalaig between Loch Maree and Gairloch. Mem. Geol. Surv. Great Britain, N.W. Highlands, 1907, p. 83.

3, 4, 5. Grunerite-magnetite-schists derived from ferrous carbonate rocks, Marquette district, Michigan. C. R. Van Hise, Monogr. U.S. Geol. Surv., 1897, no. 28, p. 338.

6. Grunerite-magnetite-slate (derived from greenalite-rock), Mesabi district, Minnesota. C. K. Leith, Monogr. U.S. Geol. Surv., 1903, no. 43, p. 144.

schistose textures indicate that they are completely recrystallized rocks. That they should be traced back eventually to rather similar original assemblages from which the eulysites are derived is, however, made clear by their chemical composition.

Origin of the Eulysites.—In referring to the best known of the eulysites—those of Tunaberg—Rosenbusch [1] cautiously expressed the opinion that these rocks were perhaps garnet-rich varieties of wehrlite. Högbom [2] concluded that the same rocks were metasomatic products of limestone. At a later date (1917) Palmgren [3] made a

[1] H. Rosenbusch, Elemente der Gesteinslehre, 1910, p. 217.

[2] A. G. Högbom, Handb. reg. Geologie, 1913, vol. 4, Abt. 3, p. 21.

[3] J. Palmgren, Bull. Geol. Inst. Upsala, 1917, vol. 14, p. 109.

detailed study of the Tunaberg occurrence. He described them as crystalline schists but left undecided their original character.

The rock type styled 'collobrierite' from Collobrières, NE. of Toulon, was described by Lacroix[1] as a new type of ferriferous crystalline schist composed of fayalite, grunerite, and magnetite. It has obviously close petrographical relations with the Tunaberg eulysites.

Eulysites were subsequently described by von Eckermann[2] from Mansjö Mt., Loos, Sweden. In this memoir he referred to the Mansjö eulysites as consolidation products of a water-rich halogen-bearing pegmatitic residual magma; but in his latest memoir[3] they are reinterpreted as derived from sediments rich in iron ores, though their mineralogical content has been influenced by secondary processes at contacts.

In 1924 Carstens[4] drew attention to the similar chemical composition of the eulysites and the 'Schwarzfels' of the Ordovician of the Trondhjem district, and he suggested that the eulysites, like the 'Schwarzfels', were derived from oolitic iron-ore or lake-ore sediments and probably represented higher grade metamorphosed products of such chemical deposits.

In describing the eulysitic iron-ores of north Sweden, Geijer[5] referred them to metamorphosed chemical sediments stating that 'the iron was probably deposited as a ferrous compound either silicate (greenalite) or carbonate'. Finally, Harker[6] classifies the eulysites as regionally metamorphosed siliceous and otherwise impure iron-ores (ferruginous deposits).

The composition and field relations of the Loch Duich rocks is in harmony with the view that they are derived from some type of ferruginous sediment, but the high grade of metamorphism they have experienced has destroyed all signs of primitive textures.

The paucity of alumina as shown in the analyses shows that these rocks did not contain original clay material. On the other hand the presence of considerable amounts of lime—especially in the hedenbergite-garnet-magnetite types—suggests that $CaCO_3$ as such or combined in ankerite or ferrodolomite formed part of the original

[1] A. Lacroix, Bull. Soc. Franç. Min., 1917, vol. 40, p. 62.
[2] H. von Eckermann, Geol. För. Förh. Stockholm, 1922, vol. 44, p. 253.
[3] H. von Eckermann, ibid., 1936, vol. 58, p. 165.
[4] C. W. Carstens, ibid., 1924, vol. 46, p. 248.
[5] P. Geijer, Årsbok Sveriges Geol. Undersök., 1925, ser. C, no. 324 (for 1925).
[6] A. Harker, Metamorphism, 1932, p. 237.

materials from which the eulysitic rocks were derived. The presence of lime perhaps tends to favour the view that the development of iron silicates like fayalite resulted from reactions between iron-bearing carbonates and silica. There is nothing in the field evidence to suggest derivation from limestone metasomatically changed to $FeCO_3$ prior to metamorphism.

In considering further the nature of the iron-rich sediment from which the eulysites are derived, attention may be drawn to the following sediment types:

(*a*) Silica–iron carbonate.

(*b*) Silica–greenalite.

(*c*) Silica–iron oxide.

The researches of Van Hise, Leith,[1] and others have shown that the iron ores of the Lake Superior region have developed from chemical sediments of types (*a*) and (*b*), and regional metamorphism of these cherty iron carbonate or cherty greenalite rocks has produced grunerite-magnetite-schists (cf. table III, analyses 3–6). When rocks of this type have been brought into contact with later basic intrusions (e.g. the Duluth gabbro), fayalite has been abundantly produced and the resulting rocks have mineralogical features in common with some eulysites.

Silica–iron carbonate assemblages are also known among bog-iron-ores, and a sediment of this character should also be given consideration more especially as bog-iron-ores are known in cases to be manganiferous. Modern examples of bog-iron-ores containing iron carbonate as well as limonite are provided by the 'Rasen Eisenstein' of Ederveen, Netherlands, described by Van Bemmelen[2] and his associates. Here the iron ores containing notable percentages (6–37) of ferrous carbonate associated with ferric oxide have been found in a sandy matrix. Analyses show also a $MnCO_3$ content rising to 4 %.

As regards assemblages of the composition silica–iron oxide (*c* above) Ramdohr[3] has described fayalite and fayalite-quartz-rocks which are referred to thermal metamorphism of primary haematite-quartz-ores in the aureole of the Brocken massif. As far as I am aware, this is the only example yet described in which a reaction between iron oxide, e.g. magnetite and quartz to produce fayalite, has been confidently expressed. The conditions demanded are clearly those in

[1] C. R. Van Hise and C. K. Leith, Monogr. U.S. Geol. Surv., 1911, no. 52.

[2] J. M. Van Bemmelen, Zeits. Anorg. Chemie, 1900, vol. 22, p. 319.

[3] P. Ramdohr, Neues Jahrb. Min., 1927, Beil. Bd. 55, p. 333.

which the iron is actively reduced to the ferrous state—a condition which appears to be seldom realized if we consider the common magnetite-quartz paragenesis of rocks consolidating or recrystallizing at high temperatures.

While a sedimentary origin for the Loch Duich rocks appears clear, some doubt must exist as to the original character of the iron-bearing material. Chemically they can be matched, as the comparative analyses show, with either original greenalite or original ferrous carbonate rocks.

The production of fayalite or grunerite by interaction of ferrous carbonate and quartz or from a ferrous silicate offers perhaps less difficulty than their formation from materials like limonite or magnetite. The formation of fayalite through reaction of magnetite and quartz would require the presence of some active reducing agent. Carbonaceous material in a sediment might fill this role, but if so evidence of it has disappeared.

The rather limited range of silica and iron oxide contents expressed in the three analyses (32–37 %) and (40–43 %) respectively might appear to favour the view that a ferrous silicate like greenalite had formed the greater part of the original rocks. The mineral greenalite with loss of water would give as an extreme composition SiO_2 53, Fe oxide 47 %.[1] The presence of significant lime (rising to 10 %) is, however, very suggestive of the presence of carbonates; and the coexistence of iron carbonates (chalybite with ferrodolomite or calcite) together with quartz, as in the Lake Superior cherty iron carbonate rocks, would yield on loss of CO_2 mixtures of similar bulk composition as these eulysites. The presence of considerable manganese is also more suggestive of derivation from original oxide or carbonate.

We can therefore only at present conclude that carbonates formed part at least of the original rocks, but whether they formed the major source of the iron of the eulysites remains uncertain.

The writer is much indebted to Dr. Alfred Harker for his kindness in executing the drawings of figs. 1–2, which accompany the text.

[1] Direct confirmation of these figures is much to be desired. Joliffe's results include metagreenalite and are obtained indirectly. Gruner (Amer. Min., 1936, vol. 21, p. 205) states that X-ray powder photographs of greenalite resemble those of serpentine.

The effects of heat on the optical orientation of plagioclase felspars.

By C. T. Barber, D.Sc., Ph.D., F.G.S., M.Inst.P.T.

[Read March 26, 1936.]

A CONSPICUOUS feature of all published diagrams, showing the results of the determination of a number of plagioclase felspars by the Fedorov method, is the pronounced scattering of the poles. They lie not only on the curves of the determinative stereogram,[1] but on either side of them, and, in fact, occupy a belt, varying in different instances, and in different positions along the length of the same curve, from 3 to 8 mm. in width. These belts usually contain, but are not symmetrically disposed to, the curves. This phenomenon has been remarked upon by Reinhard,[2] Spaenhauer,[3] and Manolescu,[4] who have considered four possible explanations of the scattering of the poles:

(*a*) That it may be due to inaccurate measurements, arising either from faulty observation, or from the use of inaccurate instruments.

(*b*) That the determinative curves are themselves incorrect.

(*c*) That the morphological directions determined are not true crystallographic directions, but vicinal directions.

(*d*) That the orientation of the indicatrix in plagioclase felspars is dependent not only on the anorthite content, but is influenced also by some other chemical component, as for example, potash.

In a previous paper[5] I have reviewed the work of these investigators, and shown that after making due allowance for the factors

[1] M. Reinhard, Universal Drehtischmethoden. Basel, 1931, plate II. [M.A. 435.]

[2] M. Reinhard, loc. cit., pp. 105–112.

[3] F. Spaenhauer, Über das Ergebnis von Messungen an synthetischen Plagioklasen mit Hilfe des Universaldrehtisches. Schweiz. Min. Petr. Mitt., 1933, Bd. 13, pp. 356–365. [M.A. 5–437.]

[4] G. Manolescu, Über die Lage der morphologischen Bezugsrichtungen bei Plagioklasen und ihre Verwendbarkeit zur Bestimmung des Anorthitgehaltes. Ibid., 1934, vol. 14, pp, 452–463.

[5] C. T. Barber, Mem. Geol. Surv. India, 1936, vol. 68, pp. 121–292.

enumerated above, there remains a residue of scattering of the pole for which previous hypotheses fail to account. In 1931, Barth described an appreciable alteration of both the position and shap of the indicatrix in labradorite under the influence of heat, and state also, that except for a slight increase in the axial angle, the pro perties of albite and oligoclase are not changed by heat. On th basis of these observations, I suggested that physical changes, an particularly the effects of heat, might be capable of explaining th residue of scattering of the poles for which previous hypothese were unable to account. In November 1935, therefore, a series c experiments were commenced with the object of ascertaining th amount and variability, both in magnitude and direction, of th displacement of the indicatrix in plagioclase felspars under the in fluence of heat. The experiments conducted are by no means ex haustive, but as I have been unable to reproduce Barth's results, an am unable to continue the investigation at the present time, i appears desirable to place on record a brief account of the result obtained.

Experiments have been conducted on albite from Alp Rischun Switzerland[2]; andesine from Esterel, France[3]; labradorite fro County Down, Ireland[4]; and anorthite from Japan.[5]

The first experiments were conducted on serial sections of andesin and labradorite, an initial section or sections being taken to establis the optical orientation of the untreated material; contiguous se ments were used for heating, and thin sections of them ground aft heat treatment. Four experiments on these lines, two each wit andesine and labradorite, revealed that the apparent change in th optical orientation, due to heat treatment, was so slight as to b commensurate with the scattering of the poles derived by determin

[1] T. W. F. Barth, Permanent changes in the optical orientation of feldspa exposed to heat. Norsk Geol. Tidsskrift, 1931, vol. 12, pp. 57–72. [M.A. 5–218

[2] W. J. Lewis, On crystals of albite from Alp Rischuna, and pericline twi from Fibbia, Switzerland. Min. Mag., 1915, vol. 17, pp. 178–188; and S. Kôz The dispersion phenomena of albite from Alp Rischuna, Switzerland. Ibid pp. 189–192.

[3] A. Lacroix, Minéralogie de la France. Paris, 1896, vol. 2, pp. 180–1 (analysis, p. 177).

[4] W. Campbell Smith, The optical orientation of labradorite from County Dow (Ireland) determined by the Fedorov method. Min. Mag., 1928, vol. 21, p 543–551.

[5] K. Makino, Anorthite crystals from Otaru in Hokkaidō. Beitr. Min. Japa 1915, no. 5, pp. 287–288. [M.A. 1–136.]

ion of a number of untreated segments. In subsequent experiments, herefore, thin sections, varying from twice to three times standard hickness, were prepared, their original optical orientation determined by the Fedorov method, and the thin section floated off for heat reatment. After heat treatment, the sections, or remains of them, vere remounted, and the optical orientation redetermined. In this vay, scattering of the original poles was eliminated and their displacement by heat treatment more accurately discernible.

In all the experiments, segments or thin sections of the felspars vere suspended in small platinum bags in a platinum resistance uenching furnace, previously raised to the required temperature. Owing to the deterioration of thermal couples maintained at high emperatures for protracted periods, the thermal couple was not etained in the furnace during the actual heat treatment of the elspars, but tests carried out for periods of three days before and fter the experiments show that the variation in temperature is well vithin the limits of $\pm 5°$ C., and all the experiments were conducted t a temperature of $1000 \pm 5°$ C. The duration of heating varied rom 200 to 500 hours, and at the end of these periods the material as immediately chilled by dropping into mercury. The cohesion f the various felspars investigated under this somewhat drastic reatment varied considerably. The labradorite, even in thin sec-on, disintegrated hardly at all, and cleavage, which was not dis-ernible in the original material, was not developed by the heating and apid chilling. The other felspars, in which cleavage was developed n the original material, disintegrated to a greater or less extent, he andesine being the most prone to disintegration, not only parting long the cleavage but also breaking into irregular fragments. In o case, however, was the disintegration so complete that the larger ragments were too small for determination.

All the felspars determined were twinned according to the albite aw, in association, in some instances, with parallel twinning on (010). s the albite composition-plane was common to them all, the change n optical orientation under the influence of heat has been expressed n terms of the displacement of the pole of (010) with reference to xed optical vectors, that is to say, in the same terms as plate II of einhard's determinative stereograms (loc. cit.). For ready reference, his stereogram is reproduced here as fig. 1, on the reduced scale of) cm. diameter. The other figures, however, in which the (010) urve of this stereogram is reproduced, are on the original scale of

20 cm. diameter, which is the smallest scale on which the displace ment of the poles is readily discernible.

In establishing the pole of (010), the position of the albite sym metry-plane was employed instead of the morphological composition

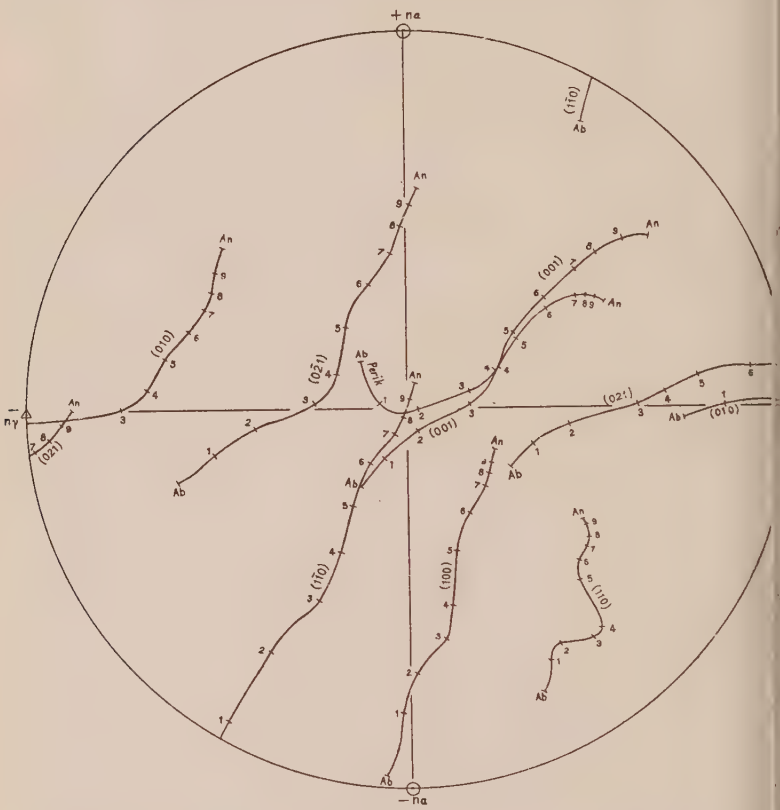
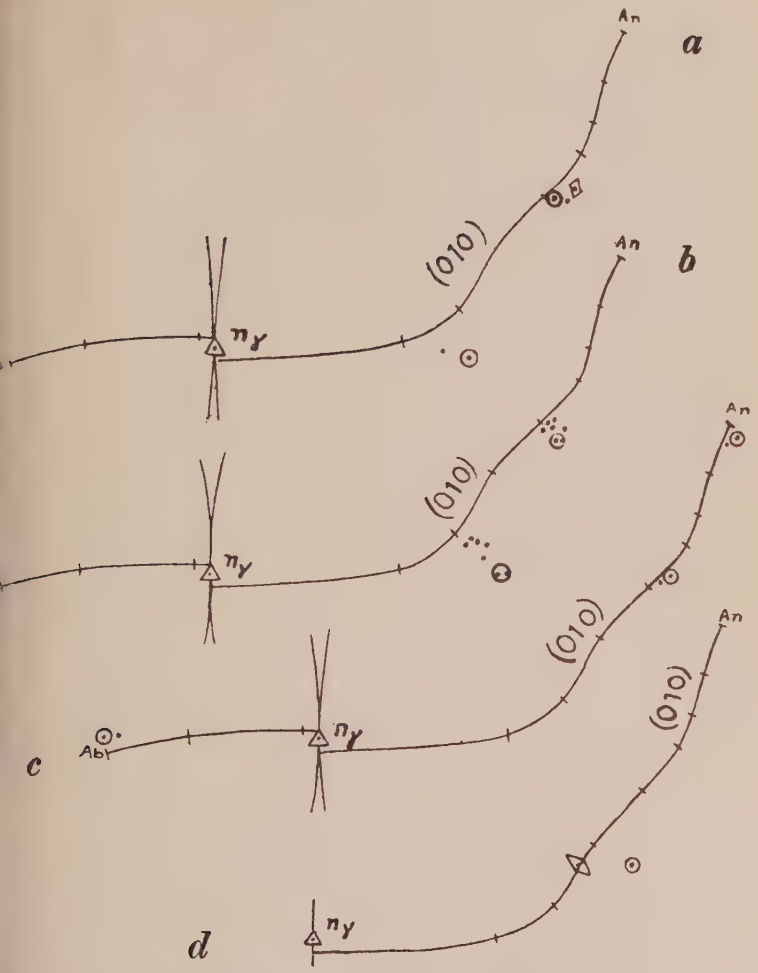


Fig. 1. Fedorov-Nikitin stereogram, after M. Reinhard. Showing the mig tion of crystallographic poles with reference to fixed optical vectors.

plane, in order to eliminate the effects of vicinal phenomena.[1] Whe other morphological directions were recognizable these were al determined, but in order to avoid the multiplication of text-figur their poles have not been reproduced. For the same reason, t whole of the data have been expressed in tabular form, but te

[1] C. T. Barber, loc. cit., pp. 238–241.



ıg. 2. Showing the effects of heating at 1000° C. on the position of the (010) in various felspars.

) Andesine and labradorite for 200 hours, and labradorite for two periods of hours. Original poles as plain dots; after 200 hours as ringed dots; after +200 hours as lozenged dot.

) Andesine and labradorite for 404 hours. Original poles as plain dots; after ing as ringed dots.

Albite, labradorite, and anorthite for 500 hours. Original poles as plain ; after heating as ringed dots.

Barth's data on heating labradorite at 1000° C. for 300 hours. Original pole zenged dot; after heating for 300 hours as ringed dot.

figures illustrating the effects of heating for 200, 404, and 500 hou are also given, so that the direction of displacement of the poles ma be more precisely recognizable. Figs. 2 *a–c* embody, respectivel the data given in lines 3, 6, and 8 ; 4 and 9 ; and 1, 10, and 12, table I. Lines 2, 4, 5, and 9, of the table, refer to the initial expe ments in which the original optics of the material treated were n determined, and in these cases the position of the final poles of (01 are compared with the collected poles of the untreated materi Fig. 2 *b* reproduces in diagrammatic form the data given in lines and 9 of the table, and is given principally to show the magnitu of the field of scattering of the poles of five specimens each of u treated andesine and labradorite.

A study of table I and figs. 2 *a–c* reveals that, except in the init experiments, in which the final pole of (010) after heat treatment compared with the field of five poles, derived by determination *other* sections of the same felspars, the maximum apparent displa ment due to heating and rapid chilling is 2°. This displacement so slight that I hesitate to suggest that it has any objective reali The accuracy of determination by the Fedorov method has be discussed by Spaenhauer (loc. cit., p. 359), who states that the po of the same felspar, determined four times, on different univer stages, and by two observers, showed a field of scattering of 2 m diameter. In this particular work. Spaenhauer was concerned w the determination of anorthite, and in this portion of the stereogra 2 mm. is equivalent to an angular distance of 2°. The appar displacement of the poles due to heat treatment cannot, therefore, said to be greater than the normal degree of experimental error. however, the direction of apparent displacement is constant, would be tempted to regard it as real. In the case of labrador (lines 5–10 of table I), on which the most experiments have b conducted, and which was the most satisfactory material for det mination, the direction is not constant. In the two initial exp ments, the apparent displacement is away from the curve and to right. While there may be some doubt as to the magnitude of displacement, as it is compared, not with an individual pole, with a field of five poles of untreated material, there is no do about its direction, as the final pole lies farther from the curve t the most distant original pole. In the subsequent experiments w labradorite, in which the optics of the same section were determi both before and after heat treatment, the direction of appar

TABLE I. Felspars heated at 1000±5° C.

Anorthite content ± 3%.	Duration of heating, in hours.	Angular displacement of pole of (010).	Direction of displacement in stereogram.	Remarks.
5%	500	2°	To the left, sub-parallel to curve.	Confirmed by displacement of pole of (001).
40	200	3° from centre of field of original poles.	Away from and to right of curve.	Confirmed by displacement of pole of (001).
40	200	2°	Away from and to right of curve.	Confirmed by displacement of the pericline pole.
40	404	3½° from centre of field of original poles.*	Away from and to right of curve.	Confirmed by displacement of the pericline and (001) poles.
60	200	2° from centre of field of original poles.	Away from and to right of curve.	—
60	200	2°	Towards the curve and to the left.	Confirmed by displacement of the pericline pole.
60	200	1½°	Towards the curve and to the left.	—
60	200+200	2°	Sub-parallel to the curve and towards the anorthite end.	Initial displacement (200 hours) 2° towards the curve.
60	404	2½° from centre of field of original poles.	Away from and to right of curve.	—
60	500	2°	Sub-parallel to the curve and towards the anorthite end.	—
95	200	None.	—	Confirmed by the absence of displacement of the pericline twin-axis.
95	500	2°	Sub-parallel to the curve and towards the anorthite end.	—

* The pole of a second specimen, determined after heat treatment, lay 5° from centre of the field of original poles.

displacement is variable. In two experiments, in both of which th section was heated for 200 hours, the apparent displacement i towards the curve, but reheating one of these sections for a furthe period of 200 hours (line 8 of table I and fig. 2 *a*) produced a com parable apparent displacement in the opposite direction. Th apparent displacement after heating for 500 hours (fig. 2 *c*) is sub parallel to the curve, instead of sub-normal to it, as in the previou cases, and is comparable, both in magnitude and direction, to th cumulative effect of treatment for two periods of 200 hours (fig. 2 *a*

In a number of cases I have stated, in the last column of table I that the results are confirmed by determinations of the poles of (001) and the pericline composition-plane. I would emphasize, howeve that this is confirmation only that the morphological directions hav been accurately determined, as any error, in the determination of th optical elements, would produce comparable displacements of a the morphological poles in the stereogram. My final view, therefor is one of doubt as to whether the very slight apparent displacement observed, and recorded in table I, have any objective reality. I view of this conclusion, it is hardly logical to discuss the variabilit of the displacement under varying durations of heat treatment, bu if they have any reality, the conclusion that their variability is ver slight appears inevitable, and it is certainly far too small to be any value as a 'geological thermometer'.

The conclusion, that the change of the optical orientation, unde the influence of heat, is so slight as to be unrecognizable with an degree of certainty, is in strong contrast with Barth's work on labra dorite. This observer states (loc. cit., p. 69): 'Labradorite, Klov steinen, Sondeled.—Several heating experiments the duration which varied from 48 to 300 hours were carried out on this minera These experiments show definitely that a pronounced change of bot the position and shape of the optical indicatrix takes place. Thes changes are shown by the projection.' The projection given en bodies the results of heating at 1000° C. for 300 hours. It is a pr jection 7·8 cm. in diameter on [010]. The better to compare th magnitude and direction of the displacement of the indicatrix wit my own results, I have carefully enlarged this projection to 20 cn diameter, and transposed it to a projection perpendicular to n_β, t conform to plate II of Reinhard's stereograms, and the other figur given in this paper. The resulting poles of (010) are shown in the relationship to the appropriate curve in fig. 2 *d*.

The angular displacement of the pole of (010) in this instance is , which is much greater than the normal degree of experimental ror. It is regrettable, however, that Barth has not given more perimental details in his paper, as the rapidity of cooling, and the gree of temperature variation during heating, may be important ctors, the effects of which, together with those of temperatures th higher and lower than 1000° C., I hope to investigate at some ture date.

Barth also investigated the effects of heat on albite and oligoclase, d states that, except for a slight increase in the optic axial angle, e properties of these minerals are not changed by heating. This in agreement with the one experiment I have conducted with bite.

During my investigations of the effects of heat on the optical ientation of the felspars, I paid attention also to its effects on the tic axial angle, the results of which are given in table II.

TABLE II. Variations in the optic axial angle of felspars due to heating at 1000 ± 5° C.

	Composition of felspar, anorthite % ± 3%.	Value of 2V before heat treatment.	Duration of heating, in hours.	Value of 2V after heating.
1.	5	79	500	80
2.	40	88 to 90	200	−88
3.	40	−88	200	−85
4.	40	88 to 90	404	−88
5.	60	80	200	78
6.	60	81	200	76
7.	60	80	200	77
8.	60	81	200+200	76
9.	60	81	404	77
10.	60	80	500	77
11.	95	−76	200	−77
12.	95	−78	500	−78

The optic axis is the least accurately determinable of the optical ctors by the Fedorov method, and the variations, noted in table II, e within the normal degree of experimental error. Since, however, ey are consistent, one is inclined to attribute some reality to them. e most surprising of these data is that relating to albite (line 1 of ble II), since E. Spencer[1] has recorded an increase of 6·8° in the

[1] E. Spencer, A contribution to the study of moonstone from Ceylon and er areas and of the stability-relations of the alkali-felspars. Min. Mag., 1930, 22, p. 346.

optic axial angle of Amelia albite, after heating to 950–1100° C. for s hours. As I have conducted only one experiment on albite, I regar my result with caution, but an increase of the order of magnitud recorded by Spencer could not have escaped detection by universa stage methods.

I am indebted to my former teacher, Prof. M. Reinhard, of th University of Basel, for the specimens of andesine investigated; Prof. C. E. Tilley, for the hospitality of his department at Cambridg for the other specimens investigated, for his personal interest in th whole of the work, and for criticizing the manuscript.

Two new meteoric stones from South Australia—Lake Labyrinth and Kappakoola.

By L. J. Spencer, C.B.E., M.A., Sc.D., F.R.S.
Formerly Keeper of Minerals in the British Museum.

[Read March 26, 1936.]

THE recovery of these two meteoric stones is due to the energy and resource of Mr. R. Bedford of the Kyancutta Museum, South Australia. They have been sent by him for description and placing on record, and he has very kindly allowed portions to be retained in the British Museum collection of meteorites. I also owe my thanks to him for the detailed information he has supplied respecting the finding of the specimens.

The Lake Labyrinth meteorite.

This stone was collected by Mr. R. Bedford in October 1934 'about twenty miles north' of Lake Labyrinth. He gives the locality more precisely as about eight miles north of Peela rock-hole and well on the Wilgena sheep station, and the latitude and longitude as approximately 30° 20′ S., 134° 45′ E. At his request it is described as the Lake Labyrinth meteorite. Peela Well I have not been able to find on any map available. Plotting the latitude and longitude as stated, I find that the spot lies between Teatree Well and Sextaing Wells,[1] 27 miles NNW. of the western end of Lake Labyrinth, and about the same distance north of the Trans-Australian railway line. It lies north of the Warburton Range.

The following graphic account of the finding of the meteorite is quoted from Mr. Bedford's letter of November 20, 1934 :

> heard a rumour that a half-caste Australian aboriginal working at shearing and that district knew of a meteorite up there, and the rumour seemed sufficiently definite to justify our making the trip, a total distance of about 600 miles motor-truck. We were successful in finding the aboriginal, who proved to be

[1] Surveyor-General's map, scale 16 miles to one inch, dated 1920. Also Surveyor-General's map, scale 8 miles to one inch, dated '190–' (received at the Royal Geographical Society in 1913).

a most intelligent and observing man, his name Billy Austin. He had just bee shearing at Kukatha station, and was on his way to North Well, a section of th great Wilgena station of 2000 square miles area. He readily agreed to com with us and show us the meteorite, from which we were then some 65 miles di tant by the station tracks. Billy informed us that a light and a rumbling nois had been heard in the district on the night of about February 5, 1924, this dat being as near as he could remember. About a fortnight later, whilst travellin on the station, he found, in the remote spot above mentioned, a hole in the groun with dirt freshly scattered around; bushes about were freshly burnt and scorche and at a little distance lay the meteorite, which was already commencing t break up, one lump lying between the hole and the meteorite. Some time afte wards he brought a piece to Mr. McBride, the owner of the station, who, he think took it to Adelaide; and he showed the spot to a visitor from Mt. Gambier, wh took a piece. For the last six or seven years Billy had not revisited the spo and apparently no one else would be able to locate it without his assistance and for these six or seven years no further attention was given to the find.

When we visited the spot we found the small crater to be at the foot of a re sandy rise; the vegetation was mulga scrub, sufficiently dense to make it in possible to have located the spot without Billy's assistance, though he himse walked onto it with perfect accuracy. Mr. Ben Peters, my assistant, who wa driving our truck, and is himself no mean bushman, was greatly impressed b the way in which Billy guided us over the long, deviating route, often witho a track visible, without a moment's hesitation. The crater, when we saw it, wa a shallow, saucer-shaped depression 12 feet across, having been largely filled u by washed and blown sand. We dug it out; it must have been originally abo 4 feet deep in the centre; we confirmed Billy's assurance that no meteorit material was present in it. The meteorite lay 30 yards west of the crater, up th slope of the sand-rise. Billy, from his original observation, was of the opinio that the meteorite had struck a glancing blow and then rolled on to the poi where it lay; otherwise I should have thought that it had been blown out of th crater by a back-fire.

Billy says that the surface [of the meteorite] was originally shiny, though it now dull, and that inside it was green. The less weathered fragments are st greenish-grey, but weathered fragments are brown. The specimen is now fragmentary that it is impossible to reconstruct it entirely; but it is clear tha it was originally a spheroid with diameters of $9\frac{1}{2}$, $8\frac{1}{2}$, and $7\frac{1}{2}$ inches. Part of th surface was rugged, with smaller and deeper 'thumb-marks', while the rest wa more regularly spherical in curvature with wide and shallow markings. Allowin for pieces that had been previously removed, the original weight of the meteori is estimated as about 75 lb. The actual total amount of the fragments recovere is 57 lb.

The material received for the British Museum collection include the following pieces:

B.M. 1935,38.—A partly crusted piece weighing 3750 grams ($8\frac{1}{4}$ lb and measuring $18 \times 15 \times 8$ cm. This is the best of the larger fra ments that were recovered. It shows prominent 'thumb-marks' o two surfaces, while a third is flatter (fig. 1). The crust is preserve but is stained with a film of limonite. There are three large broke

ounded edges. The prism faces and two of the edges are approxi-ately perpendicular to the base, while the third edge is undercut. he surface is even and smooth, without any 'thumb-marks'. The notograph (fig. 2) gives an inadequate idea of the shape of the stone,

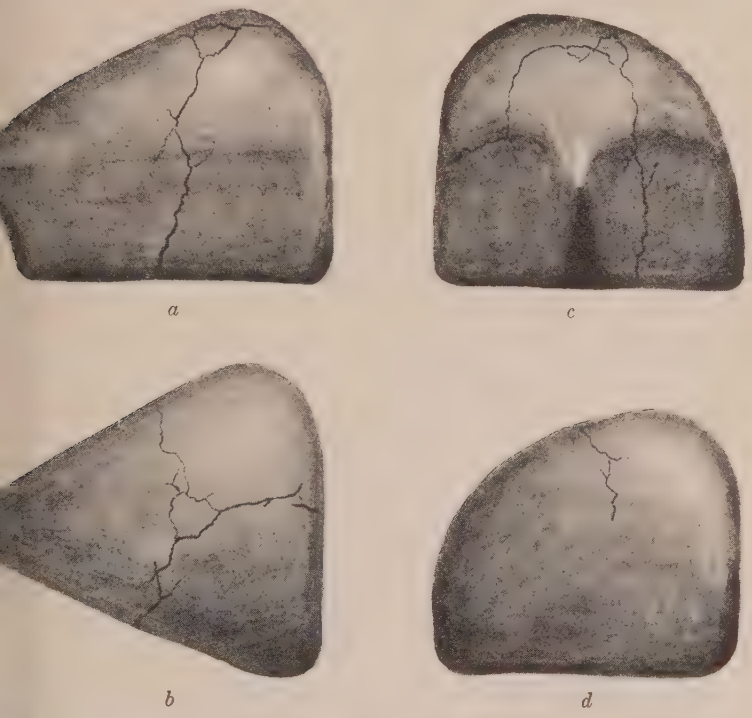


FIG. 3. Sketches of the Kappakoola meteoric stone. $\times \frac{2}{3}$. (*a*) elevation, (*b*) plan, (*c*) and (*d*) end views.

ich is better represented by the shaded sketches (fig. 3 *a–d*). The reme dimensions in two directions at right angles are 7·1 × 5·3 cm., fig. 2*a*, and 7·1 × 5·5 cm., in fig. 2*b*. The dome was no doubt the nt of the stone during its flight through the earth's atmosphere. The original fusion crust of the stone has been mostly altered to dark brown skin of limonite with a minutely warty surface, in ich a few grains of sand have become cemented. There are deep l prominent cracks in the stone. When found the stone was said be black and glossy, and not cracked; and it had evidently changed er being kept for six years in a damp shed. This may be taken

as an example of the rapid disintegration to which meteoric stones are liable.

The cut and burnished section of the stone shows a rather thick sprinkling of bright metallic grains of nickel-iron. These are evenly distributed, and are ½ mm. or less across. Fewer grains of bronze-coloured troilite are seen. The ground is a granular aggregate of crystalline stony matter speckled with limonite. Chondrules are few and inconspicuous, and do not exceed 1 mm. in diameter. The specific gravity is 3·59, as determined by Mr. S. E. Ellis in the Mineral Department of the British Museum by hydrostatic weighing of the piece of 45·108 grams.

A thin micro-section shows large numbers of broken angular fragments up to 1½ mm. across of clear colourless olivine surrounded by limonite. Only a few chondrules up to 1 mm. in diameter are shown. One consists of lath-shaped crystals of olivine, another of finely granular olivine, and a third of fibrous enstatite. The stone may be described as a dark grey, minutely brecciated olivine-chondrite with a medium amount of nickel-iron.

Unfortunately there is still difficulty in obtaining information about South Australian meteorites, some of which remain undescribed. Their positions given on the sketch-map in this Magazine[1] are not in all cases correct. Kingoonya, in particular, being placed to the west on the Nullarbor Plains, is quite out of place; and Murnpeowie is also out of place. Rather than drawing another sketch-map from still insufficient data, the following list is given of South Australian meteorites (apart from those of Central Australia and North Australia) with the approximate latitude and longitude of each so far as can be determined.

[1] L. J. Spencer, Min. Mag., 1932, vol. 23, p. 41.

South Australian meteorites.[1]

Accalana,[2] undescribed, found before 1917. 29° 14′ S., 139° 57′ E.

Cadell, stone ?, found 1910. 34° 2′ S., 138° 40′ E.

Carraweena,[2] undescribed, found before 1917. 29° 10′ S., 139° 59′ E.

Glen Osborne, undescribed.

Kappakoola, stone, found 1929. 33° 20′ S., 135° 30′ E. (p. 357 bove).

Karoonda, stone, fell Nov. 25, 1930. 35° 6′ S., 139° 51′ E. (Min. bstr. **5**–15, **6**–16).

Kingoonya, stone, found before 1927. 30° 56′ S., 135° 24′ E. (p. 356 bove).

Kyancutta, iron, found 1932. 33° 19′ S., 136° 2′ E. (Min. Mag. **3**–329).

Lake Labyrinth, stone, found 1924 (? fell Feb. 5, 1924). 30° 20′ S., 34° 45′ E. (p. 353 above).

Murnpeowie, iron, found 1909. 29° 35′ S., 139° 54′ E. (Min. Mag. **4**–13).

Rhine Villa, iron, found 1900. 34° 38′ S., 139° 17′ E.

Weekeroo, iron, found 1924. 32° 16′ S., 139° 52′ E. (Min. Abstr. -159).

Yardea, iron, found 1875. 32° 22′ S., 135° 31′ E.

[1] C. Anderson, A catalogue and bibliography of Australian meteorites. Rec. ustr. Mus., 1913, vol. 10, pp. 53–76; G. T. Prior, Catalogue of meteorites, ritish Museum, 1923, 1927.

[2] Accalana and Carraweena may possibly belong to the same fall, the localities ing only five miles apart (see Min. Mag., 1935, vol. 24, p. 14, footnote). Along ie same line and four miles farther north is Artracoona. This may perhaps be ie locality of the 'Artracoona meteorite', also undescribed, which has been ted under Central Australia but not further localized.

The reciprocal role of alumina in reaction series.

By Alfred Brammall, D.Sc., Ph.D., D.I.C.
Geological Department, Imperial College of Science and Technology, London.

[January 30, 1936.]

INQUIRY into this feature was stimulated by a reasonable doubt concerning the reality of the immiscibility gap in the clinoenstatite-diopside series. The existence of this gap was first suspected by Sosman[1] and Asklund,[2] and the identity of the gap with the composition field of the hornblendes has recently been suggested by Kennedy,[3] whose comparative study of hornblende and pyroxene composition engaged statistical methods applied in the first instance by Asklund.

While this paper confirms and extends the findings of both Asklund and Kennedy, the latter author recognized the possibility that the statistical methods employed might, by reason of their arbitrary nature, invalidate conclusions based upon them.

Asklund's ternary diagram[4] purports to show the MgO–CaO–FeO ratios of the pyroxenes and the metasilicate proportions of pyroxene bearing rocks. But the quantities of these three oxides plotted in any particular case represent only a residuum of a full analysis from which alumina, ferric oxide, titania, and alkalis have been eliminated by allotments to normative compounds (anorthite, magnetite, &c.), though all these constituents (alumina, &c.) are liable to incorporation in both the pyroxene and the amphibole constitution. The fact that this method of computation did actually serve to detect the immiscibility gap is perhaps an index to the magnitude of the gap rather than to the cogency of the method itself.

[1] R. B. Sosman, Minerals and rocks of the composition $MgSiO_3$–$CaSiO_3$–$FeSiO$. Journ. Washington Acad. Sci., 1911, vol. 1, pp. 54–58.

[2] B. Asklund, Petrological studies in the neighbourkood of Stavsjö . . . Årsbo. Sveriges Geol. Undersök., 1923, vol. 17, no. 6, pp. 75–88.

[3] W. Q. Kennedy, The influence of chemical factors on the crystallization of hornblende in igneous rocks. Min. Mag., 1935, vol. 24, pp. 203–207.

[4] W. Q. Kennedy, loc. cit., p. 205, fig. 1.

Having regard to the results of X-ray work on the crystal-structure nd constitution of both pyroxenes and amphiboles, the formulation f a pyroxene (or hornblende) composition in terms of empirical molecules' and their normative compounds is liable to obscure ignificant facts concerning mineral variation: atomic, as opposed to iolecular, interplay is the mechanism of mineral change in general. he varietalism displayed by pyroxenes and amphiboles in particular largely due to interplay between (*a*) atoms individually, e.g. i⇋Al, Al⇋Mg, Mg⇋Fe″⇋Mn, K⇋Na⇋Ca, &c., and (*b*) atom ssociations, e.g. (CaAl)→(MgSi) in the progressive aggradation of etamorphic hornblende,[1] and (NaAl)→(CaMg) accompanying the ange actinolite→glaucophane. This aspect of the case alone would iscount the validity of Asklund's method, which nevertheless did veal one linear dimension of the immiscibility gap.

In fig. 1, some hundreds of selected analyses have been plotted on atomic basis: the polar terms are atoms—grouped consistently ith their known replacement relationships. Of the three polar rms in Asklund's diagram, two (MgO and FeO) are accommodated, atoms, at a single pole in fig. 1, which therefore reduces Asklund's gram to a linear arrangement of points along the base-line of the ure, but supplies an additional co-ordinate engaging (AlFe‴) atoms. herwise, the figure is self-explanatory, and serves to strengthen e case made out by Kennedy: the composition field of the horn-endes includes the immiscibility gap in the pyroxene series. Fig. 1 fords a convenient basis for an examination of the role of Al atoms the two reaction series.[2]

In the continuous reaction series, the actual mechanism of reaction the replacement of atomic Ca by atomic Na, and of atomic Al by omic Si, i.e. (NaSi)→(CaAl), while the initial pattern, or 'class' crystal architecture, $n(SiO_2)$, persists unchanged. It may be ex-ressed thus:

Albite←Anorthite
(NaSi)→ (CaAl).

In the initial term anorthite, $Ca(Al_2Si_2)O_8$, one-half of the Si atoms e already replaced by Al atoms; but in the final term, albite, only e-fourth of the Si atoms are so replaced. Hence, progressive change the sense anorthite→albite implies the progressive elimination

[1] J. D. H. Wiseman, Quart. Journ. Geol. Soc. London, 1934, vol. 90, pp. 354–7.

[2] N. L. Bowen, The evolution of the igneous rocks. 1928, p. 60.

of Al atoms, and this change is graphically indicated in fig. 1 by th displacement of plagioclase evolutes *away from* the (AlFe‴) pole.

Pari passu with this continuous change in the plagioclase series

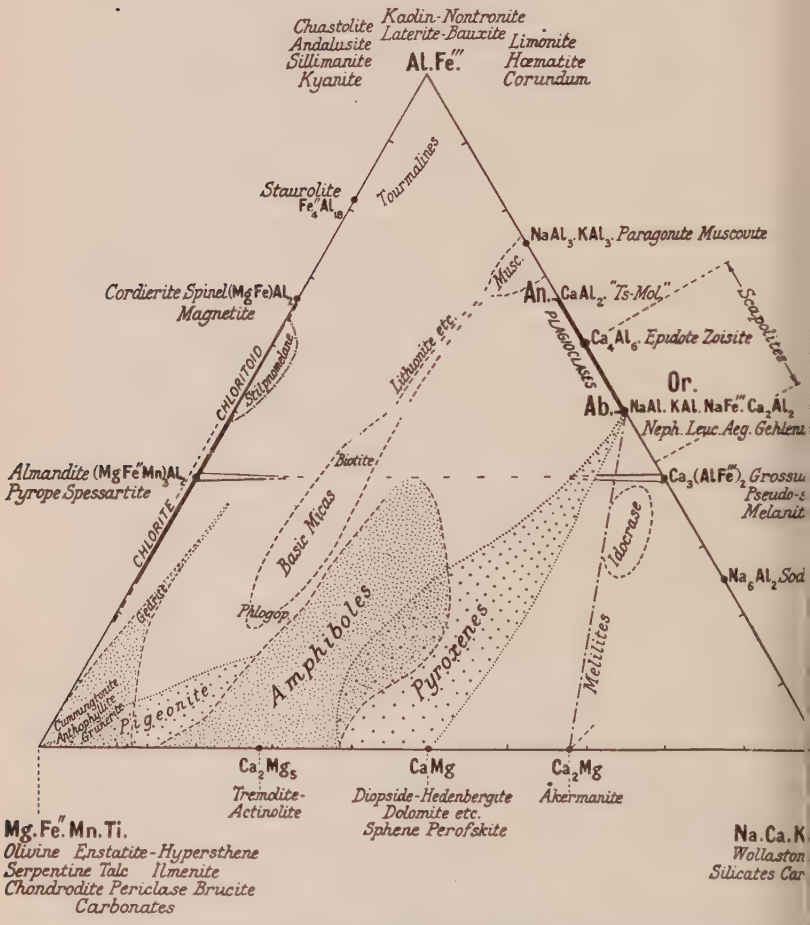


FIG. 1. Showing the composition fields for the chief rock-forming mineral Some hundreds of carefully selected analyses are plotted on an *atomic* basis (i conformity with the results of X-ray work), silicon, phosphorus, hydrogen, &c being 'in reserve'. This figure is reproduced from 'Science Progress', 193(vol. 30, p. 619, and thanks are due for the loan of the block.

the discontinuous reactions proceed in the sense olivine → biotite (vi augite and hornblende). These discontinuous changes are character ized by the enrichment of successive evolutes in (AlFe‴) atoms

ıccession being indicated by displacement *towards* the (AlFe‴) ole.

There is considerable warrant for the conclusion that the first Al toms to gain access to the pyroxene constitution enter via the ' class'

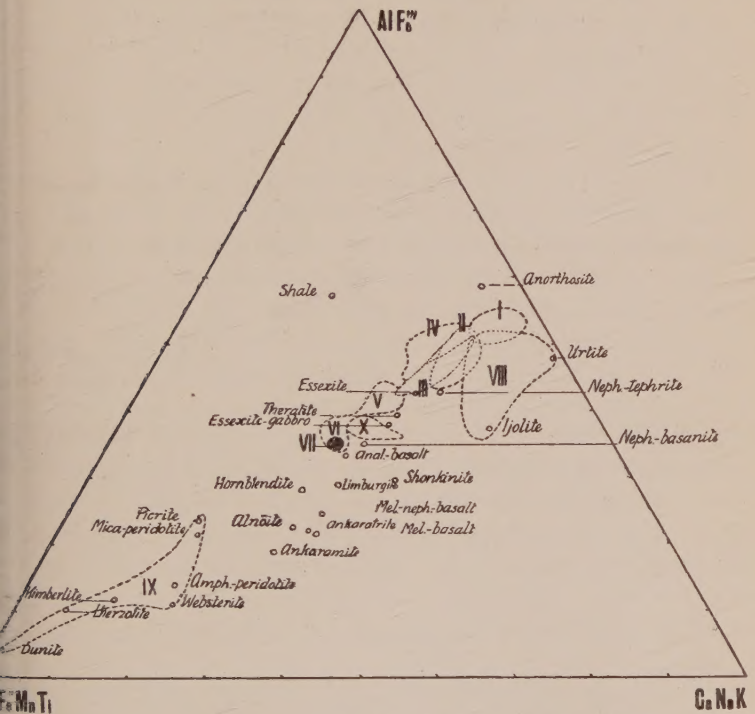


Fig. 2. Showing the composition fields for the main rock ' clans ' (comprising oth intrusive and extrusive types) and some individual rock types plotted from e ' average compositions ' given in table I (pp. 9–28) of igneous rocks and the pths of the earth, by R. A. Daly, 1933. I, granites, &c.; II, quartz-monzo-tes, granodiorites, &c.; III, sub-alkali syenites, &c.; IV, diorites, tonalites, c.; V, norites, &c.; VI, gabbros, &c.; VII, plateau-basalts, &c.; VIII, alkali-enites; IX, ultrabasic rocks; X, lamprophyres.

roup (or radix) distinctive of pyroxene structure, i.e. via the (SiO_3) roup. This implies that Al atoms initially displace Si atoms; hereas in plagioclase evolution directed towards albite, Si atoms splace Al atoms. Hence the role of Al atoms in the two reaction ries is in some manner reciprocal; but the feature is so intimately ound up with magmatic problems still at issue that discussion of

its implications here would involve tedious excursions into pu hypotheses.

It is as yet uncertain whether Al atoms acquired by an early-stag augite pass—by entail as it were—into derivative hornblende an biotite. Moreover, the constitution of the end-terms aegirine, ri beckite, and lepidomelane suggest that in the waning phases of mag matic crystallization, the effectiveness of the Al→Si replacemen becomes enfeebled before the reaction Al→Mg, while enfeeblemen of the latter is somewhat compensated by the displacement of A atoms by Fe‴ atoms.

Reverting to the reciprocal role of the Al atoms in the two reactio series: this could be graphically illustrated by the swing of a com pass-needle pivoted somewhere between the composition fields occu pied by the two reaction series. The crystallization-differentiatio theory would require that the pivot should itself be progressively displaced—from an initial 'station' in the ultrabasic or gabbro field towards a granitic 'station', with numerous possible arre points in the dioritic, granodioritic, monzonitic, syenitic, and oth composition fields—each covering the entire 'family' (intrusive an extrusive terms included). As a matter of interest, an attempt ha been made to determine approximate loci for these 'family' station on the reasonable assumption that Daly's 'averaged' analyses affor the best available basis for defining these composition fields, th whole of these analyses have been plotted in fig. 2, and the centr of the fields so defined may be regarded as the loci of the 'stations

The purpose of this paper is to call attention to certain relatio ships which, superficially at least, dovetail into each other, but whe examined in the light of various rival theories concerning petr genesis, lend themselves to a bewildering variety of alternati explanations.

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Printed in Great Britain by John Johnson, at the University Press, Oxf

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117 Chamberlayne Road, Kensal Rise, N.W.10